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NATIONAL BUREAU OF STANDARDS
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AMERICAN STANDARD SPECIFICATION FOR DRY CELLS AND BATTERIES

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PREFACE

The publication of this revision of the American Standard Specification for Dry Cells and Batteries marks the completion of another step in the development of a specification which had its inception in the need for a purely governmental standard during the critical years of 1917 and 1918. Since then, manufacturers of dry cells and the largest industrial users of them have cooperated with representatives of the Government in perfecting tests and specifications for the varied kinds of dry cells and batteries. This work has been accomplished through a Sectional Committee of the American Standards Association, acting under the sponsorship of the National Bureau of Standards.

Within the past few years new types of cells have been developed to meet new industrial uses and the available output of the better brands of older types is now three- to fourfold greater than 20 years ago. These advances were made possible by the ability and willingness of manufacturers to improve their product. The resulting benefits are shared by the Government and the public alike. The National Bureau of Standards is glad to have a part in this work. Future revisions will undoubtedly become necessary, as they have in the past, because the value of the specifications depends on their keeping pace with advances made in the art.

LYMAN J. BRIGGS,
Director, National Bureau of Standards.

December 17, 1936.

HISTORY OF THE PROJECT

In 1912 a committee [1] of the American Electrochemical Society recommended standard methods of testing dry cells. Although much has been accomplished in developing specifications for dry cells and batteries since that time, the influence of these early recommendations on some of the later specifications is still discernible.

The preparation of nationally recognized specifications to include sizes of cells, arrangement of batteries, tests, and required performance began in 1917 with the drafting of specifications which were later submitted by the National Bureau of Standards to a committee including representatives of manufacturers, the War Industries Board, and several Government departments. The specifications which were approved at that time were published in 1919 as an appendix to the Bureau's Circular [2] on dry cells. Within a few years the need for revision became apparent and the Bureau was asked to call a conference of representatives of manufacturers, government departments, and some of the largest individual users of dry cells. This conference met in December 1921 and agreed on a standardization program for sizes of cells and batteries, tests, and performance. New specifications were published in the second edition of the Bureau's circular [3] on dry cells, and following their adoption as a Government standard they were issued separately.[4]

In 1924 a committee consisting of representatives of the Government, battery manufacturers, and several large users of dry cells agreed on a standard system of nomenclature for dry cells and batteries. This has been used in subsequent revisions of the specifications. This committee initiated a movement for a more representative and permanent organization to deal with subsequent revisions of the dry cell specifications with the result that the American Engineering Standards Committee (now the American Standards Association) authorized the formation of a sectional committee on dry cells under the sponsorship of the National Bureau of Standards. This committee has been active since its organization in 1926 and has prepared three revisions of the specifications, which became American Standards in 1928,[5] 1930,[6] and 1937.[7]

Close cooperation has been maintained between this sectional committee and the technical committee on dry cells reporting to the Federal specifications committee with the result that Federal specifications issued in 1931 [8] and 1935 [9] have been concordant with American standard specification, although differing in form. The 1935 specification anticipated many of the changes incorporated in the 1937

[1] Trans. Am. Electrochem. Soc. **21**, 275 (1912).
[2] Cir. BS 79, 39 (1919).
[3] Cir. BS 79, 2d ed., 54 (1923).
[4] Cir. BS 139 (1923); U. S. Government Standard Specification no. 58.
[5] Cir. BS 139, 2d ed. (1927); U. S. Government Master Specification no. 58a; ASA Standard C18—1928.
[6] Cir. BS 390 (1930); ASA Standard C18—1930.
[7] Cir. BS C414 (1937); ASA Standard C18—1937.
[8] Federal Standard Stock Catalog, Specification Symbol W–B–101 (March 31, 1931).
[9] Federal Standard Stock Catalog, Specification Symbol W–B–101a (May 7, 1935).

American Standard, but did not include batteries intended primarily for use with hearing-aid devices.

Periodic revision of the American Standard specifications becomes necessary as a result of changes in the art. New types and uses for batteries required the drafting of new specifications to cover industrial flashlight cells and hearing-aid batteries, and the greatly improved performance of batteries justified increased requirements, as in the case of some varieties of general-purpose and telephone batteries. The new specifications, therefore, reflect the advances made by manufacturers in their product. How great these advances have been during the past years may be judged from a few examples taken from a recent paper by Gillingham.[10] His performance figures relate to the better brands available at the time, but are not necessarily confined to the product of any particular manufacturer.

The spontaneous shelf deterioration of dry cells of the ordinary no. 6 size for general purposes, occurring in 6 months, was reduced from 35 percent in 1901 to 25 percent in 1916 and to 7 percent in 1934.

The useful output of dry cells, measured by their service life on various tests, described in the accompanying specifications, has been materially increased. Cells of the telephone type, made in 1910, gave 155 days of service on the light intermittent test; those made in 1916 gave 165 days and the output was increased in 1926 to 230 days. About 1930, special grades of telephone cells became available giving 360 days, and some cells of 1934 reached 450 days.

In 1910, flashlight cells of the *D* size gave 260 minutes of service on the 4-ohm intermittent test, but in 1934, cells of this type yielded as high as 750 minutes.

Industrial flashlight cells, intended for heavier service than the ordinary flashlight cells, appeared on the market about 1930, at which time they gave 250 minutes of service on the heavy-industrial test. Subsequent improvements were made rapidly with the result that 975 minutes of service on the same test were obtainable from cells made in 1935.

Radio *B* batteries, which appeared about 1918, gave 377 hours on the 5,000-ohm continuous test, but in 1926, batteries containing the same size of cell gave 1,000 hours, and this was increased to 1,500 hours of service from batteries made in 1934.

Hearing-aid batteries (*CD* size) gave 18 hours of service in 1932. In 1935, similar batteries gave 50 hours of service.

These examples illustrate improvements which are the result of organized research and development on the part of manufacturers and of standardized test procedures and specifications attained through cooperation of the groups represented on the sectional committee. To allow for manufacturing variations and to obtain adequate competition it is necessary that the minimum required performance of the various types and sizes of cells included in the specifications be somewhat less than the maximum figures quoted above. The proportion of poorer brands on the market has decreased during the past few years. The result of all these factors has been a considerable gain to the public at large.

[10] Trans. Electrochem. Soc. 68, 159 (1935).

The personnel of the sectional committee is as follows:

Organization represented	Name and business affiliation
American Institute of Electrical Engineers.	E. D. Doyle, Leeds & Northrup Co., Philadelphia, Pa.
American Society for the Hard of Hearing.	Douglas Macfarlan, M. D., Philadelphia, Pa.
Association of American Railroads, Signal Section.	A. B. Himes, Baltimore & Ohio Railroad, Baltimore, Md.
Association of American Railroads, Telephone and Telegraph Section.	G. R. Stewart, Illinois Central Railroad, Chicago, Ill.
Association of Edison Illuminating Companies.	H. C. Koenig, Electrical Testing Laboratories, New York, N. Y.
Bright Star Battery Co.	C. G. Birdsall, Bright Star Battery Co., Clifton, N. J.
Burgess Battery Co.	H. E. Lawson, Burgess Battery Co., Freeport, Ill.
Electrochemical Society.	C. A. Gillingham (secretary of committee), National Carbon Co., Cleveland, Ohio.
Independent Engineer.	W. B. Kouwenhoven, Johns Hopkins University, Baltimore, Md.
Institute of Radio Engineers.	H. M. Turner, Yale University, New Haven, Conn.
National Bureau of Standards.	J. P. Schrodt, National Bureau of Standards, Washington, D. C.
	G. W. Vinal (chairman of committee), National Bureau of Standards, Washington, D. C.
National Electrical Manufacturers Association.	C. A. Gillingham, National Carbon Co., Cleveland, Ohio.
	Ralph E. Ramsay, Ray-O-Vac Co., Madison, Wis.
	G. H. Schroeder,[a] Marathon Battery Co., Wausau, Wis.
	W. G. Waitt, General Dry Batteries, Inc., Cleveland, Ohio.
	Alternate: C. P. Deibel, General Dry Batteries, Inc., Cleveland, Ohio.
	Alternate: Ralph Friess, Ray-O-Vac Co., Madison, Wis.
	Alternate: E. J. McEachron,[a] Marathon Battery Co., Wausau, Wis.
National Electrical Wholesalers Association.	G. K. Heyer, Graybar Electric Co., New York, N. Y.
Radio Sectional Committee.	F. T. Bowditch, National Carbon Co., Cleveland, Ohio.
Telephone Group, ASA.	E. B. Wheeler, Bell Telephone Laboratories, Inc., New York, N. Y.
U. S. Independent Telephone Association.	A. L. Staderman, Citizens Independent Telephone Co., Terre Haute, Ind.
U. S. Navy Department.	Officer in Charge,[b] Specification Section, Design Division, Bureau of Engineering, Navy Department, Washington, D. C.
U. S. War Department.	Maj. H. P. Browning,[c] Signal Corps, War Department, Washington, D. C.
	Alternate: L. H. Judson, Signal Corps, War Department, Washington, D. C.

[a] Appointed after vote on C18–1937 was taken.
[b] Comdr. R. W. Bruner, at time vote on C18–1937 was taken.
[c] Appointed to succeed Maj. W. C. Ellis, who was the committee member at time vote on C18–1937 was taken.

AMERICAN STANDARD SPECIFICATION FOR DRY CELLS AND BATTERIES

(American Standard C18–1937)

CONTENTS

I. DEFINITIONS

(a) Dry cells and batteries to be included under this specification shall fulfill the following requirements in addition to those in other paragraphs of this specification:

The cells shall be of sal ammoniac type with depolarizer.

The cells shall have a nonspillable electrolyte.

(b) Metric dimensions, corresponding to the dimensions in inches, are shown in this specification as a matter of convenience, and are nominal only, being accurate to the nearest millimeter.

II. NOMENCLATURE

(a) For reference in this specification, the following system of nomenclature shall be used to designate sizes and types:

(b) The large cylindrical dry cell, 2½ by 6 inches (63 by 152 mm), shall be designated as no. 6. Smaller cells shall be designated by the letters in accordance with table 1, which gives nominal dimensions of the zinc container.

TABLE 1.—*Nominal dimensions of zinc containers*

Cell designation [a]	Diameter	Height over can	Metric dimensions
	Inches	*Inches*	*Millimeters*
AAA	½	1	13 by 25.
AA	½	1⅞	13 by 48.
A	⅝	1⅞	16 by 48.
B	¾	2⅛	19 by 54.
C	1 5/16	1 13/16	24 by 46.
CD	1	3⅜	25 by 86.
D	1¼	2¼	32 by 57.
E	1¼	2⅞	32 by 73.
F	1¼	3 7/16	32 by 87.
G	1¼	4	32 by 102.

[a] Includes cells of other than cylindrical form and of equivalent rated capacity.

(c) Flashlight, radio, and similar batteries which consist of more than one cell shall be designated by a style letter indicating the shape or other designation of the battery; a number indicating the number of cells contained; and finally a letter indicating the size of cell according to table 1. The style letters are as follows:

Style letter	Shape or other designation of the battery
G	Group batteries, primarily railway-lantern batteries.
H	Horizontal batteries; one horizontal row or layer of cells.
V	Vertical batteries; cells arranged in layers, one layer above another, primarily for radio use.

(d) Assembled batteries containing no. 6 cells shall be designated by letters and numbers. The first number designates the number of cells in the battery and the second number the size of cell, followed by the letter *S* or the letter *D*, according to the arrangement of the cells in a single or double row.

III. GENERAL CLASSIFICATION OF CELLS AND BATTERIES

(a) The following classes of dry cells and batteries are included in this specification:

No. 6 general-purpose dry cells (includes radio cells).
No. 6 industrial dry cells (universal type).
No. 6 and sizes *D* and *E* telephone cells (light service cells).
Assembled batteries of no. 6 cells.
Group batteries of small cells (for no. 6 dry-cell applications).
Flashlight cells and batteries.
Batteries for hearing aids.
Radio *B* batteries.
Radio *C* batteries.

IV. STANDARD SIZES OF CELLS AND BATTERIES

(a) *No. 6 Dry cells.*—The dimensions for the zinc container of the cell, measured without the jacket, are: Diameter, 2½ inches (63 mm); height, 6 inches (152 mm). Deviations shall not exceed 1/16 inch (1.6 mm) in diameter and ⅛ inch (3.2 mm) in height from the dimensions as given in inches. The over-all dimensions including the jacket and terminals shall not exceed: Height, 6¾ inches (171 mm); diameter, 2⅝ inches (67 mm).

(b) *Assembled batteries of no. 6 cells.*

Table 2

Battery designation	Assembly		Nominal battery voltage	Maximum dimensions			Metric dimensions
	No. of cells	No. of rows		Length	Width	Height	
			Volts	*Inches*	*Inches*	*Inches*	*Millimeters*
4S	4	1	6	10⅝	2¾	7½	270 by 70 by 190.
4D	4	2	6	5⅜	5⅜	7½	137 by 137 by 190.
5D	5	2	7½	8	5⅜	7½	203 by 137 by 190.
6D	6	2	9	8	5⅜	7½	203 by 137 by 190.

(c) *Group batteries of small cells* (for no. 6 cell applications).—Cells contained in these batteries may be of various sizes as preferred by the manufacturer. Batteries shall comply with the dimension requirements of table 3.

TABLE 3

Nominal battery voltage	Maximum dimensions			Metric dimensions
	Length	Width	Over-all height	
Volts	*Inches*	*Inches*	*Inches*	*Millimeters*
1½	2⅝	2⅝	5	67 by 67 by 127.
3	4	2¾	6	102 by 70 by 152.
4½	4	4	6	102 by 102 by 152.

(d) *Flashlight batteries.*—These batteries contain cells of sizes given in table 1.

TABLE 4

NOTE.—Types *T2AA*, *T2C*, *T2D*, and *T3D* of the previous specification have been eliminated. It is recommended they be replaced by the unit cells *AA*, *C*, and *D* listed below

Battery designation	Maximum dimensions			Minimum dimensions		
	Diameter	Height	Metric dimensions	Diameter	Height	Metric dimensions
	Inches	*Inches*	*Millimeters*	*Inches*	*Inches*	*Millimeters*
AA	9/16	1 31/32	14 by 50	17/32	1 29/32	13 by 48.
C	1 1/32	1 31/32	26 by 50	3 1/32	1 7/8	25 by 48.
D	1 11/32	2 13/32	34 by 61	1 9/32	2 5/16	33 by 59.
G4F	[a] 3⅜	[b] 4	86 by 102		[b] 3 13/16	97.

[a] Maximum diagonal measurement on this battery, which must pass through a circle 3⅜ inches (86 mm) in diameter.
[b] Body height, exclusive of terminals.

(e) *Batteries for hearing aids.*—These batteries contain cells of sizes given in table 1, cells being connected in series.

TABLE 5

Battery designation	Maximum dimensions			Metric dimensions
	Length	Width	Body height	
	Inches	*Inches*	*Inches*	*Millimeters*
H3B	2½	⅞	2⅞	63 by 22 by 73
H3C	3 1/16	1 1/16	2⅝	78 by 27 by 67
H2CD	2 3/16	1⅛	4⅛	55 by 29 by 105
H3CD	3¼	1⅛	4⅛	83 by 29 by 105

(f) *Radio B batteries.*—These batteries commonly contain cells of standard sizes given in table 1, the cells being connected in series.

TABLE 6

NOTE.—Maximum over-all height may be increased ⅛ in. (3 mm) for all batteries provided with plug-in sockets, with adaptors in place.

Battery designation	Maximum dimensions				Metric dimensions			
	Length	Width	Body height	Over-all height	Length	Width	Body height	Over-all height
	Inches	*Inches*	*Inches*	*Inches*	mm	mm	mm	mm
V30AAA	3⅛	1⅜	3⅞	4½	79	35	98	114
V30AA	3⅛	2⅜	3⅞	4½	79	60	98	114
H15A	3½	2 3/16	2 11/16	3 7/16	89	56	68	87
H15B	4¼	2⅜	3	3½	108	67	76	89
V30B	4⅜	2 1/16	6	6⅝	111	68	152	168
V30D	8¼	3 5/16	7⅜	7 15/16	210	84	187	202
V30F	8¼	4½	7⅜	7 15/16	210	114	187	202
V30G	8¼	4½	7⅜	7 15/16	210	114	187	202

(g) *Radio C batteries.*—These batteries commonly contain cells of standard sizes given in table 1, the cells being connected in series.

TABLE 7

NOTE.—Maximum over-all height may be increased ⅛ in. (3 mm) for all batteries provided with plug-in sockets, with adaptors in place.

Battery designation	Maximum dimensions				Metric dimensions			
	Length	Width	Body height	Over-all height	Length	Width	Body height	Over-all height
	Inches	*Inches*	*Inches*	*Inches*	mm	mm	mm	mm
H3B	2½	⅞	3	3½	63	22	76	89
H5B	4¼	15/16	3	3½	108	24	76	89
H15B[a]	4¼	2⅜	3	3½	108	67	76	89
H3D	4 1/16	1½	3 3/16	3 15/16	103	38	81	100

[a] Batteries used as *C* batteries and also as *B* batteries shall be marked as *C* batteries and be accompanied by a statement indicating how they may be used as *B* batteries.

V. MATERIAL AND WORKMANSHIP

(a) The material and workmanship shall be first class in every particular. Cells or batteries having any of the following defects shall be considered as not complying with this part of the specification: Loose terminals, spring clips, or plug-in terminals which do not make and maintain positive connections to the external circuit, high or low carbons, corrosion of metal cap on carbon rods, carbon rods off center, loose or cracked seals, leaking or distorted zinc containers. Cells and assembled batteries shall be free from deformation and leakage during their useful life under specified test conditions.

VI. JACKETS

(a) The individual cells, except those in assembled batteries, flashlight batteries, and radio batteries, shall be inclosed in a close-fitting jacket of news, chip, or straw board. For special purposes jackets may be treated, when so specified, with paraffin or other waterproofing material. Such waterproofing material shall not be allowed to cover the cell terminals.

VII. MARKING

(a) On the outside of the jackets of individual cells and outside of batteries shall be printed the following information:

The trade name of the cell or battery.

The name of the manufacturer or supplier, or such trade-mark as will identify him.

Number or other designation of size.

The date of manufacture, or the expiration of a guaranty period, indicated as such. (Option: This may be shown on the zinc container, if plainly visible.)

VIII. ZINC

(a) The anode shall be made from smooth zinc, free from flaws, blisters, and cracks.

IX. SEALING COMPOUND

(a) The sealing compound shall be an insulating material which shall not flow at a temperature of 45° C (113° F) during a static test in which the sealed surface is held vertical for a period of 24 hours.

X. MECHANICAL TOP CLOSURE

(a) Metal or composition covers for closing the top of no. 6 dry cells and flashlight cells may be used in lieu of sealing compound, provided that such covers and accessory parts shall not become adversely affected during the useful life of the cell or battery by leakage, corrosion, or deformation. Metal covers of individual cells shall in every case be permanently insulated from one or preferably both electrodes. Metal boxes and covers of assembled batteries shall in every case be insulated from the cells comprising the battery.

(b) In assembled batteries of all types, the top closing means may be metal, fibre, or paper board, in lieu of sealing compound.

XI. TERMINALS AND CELL CONNECTIONS

(a) *No. 6 cells.*—The terminals shall be of the knurled-nut-and-screw type (thread 8–32), or spring clips if specified. They shall be of brass or equally suitable metal. The terminals shall not be obstructed by the cardboard jacket, solder, or protruding material of the seal.

(b) *Assembled batteries of no. 6 cells* (table 2).—The batteries shall have soldered connections between the individual cells. The terminals shall be brought through the top of case or sealing material to binding posts or spring clips. The polarity of the terminals shall be marked.

(c) *Group batteries of small cells* (table 3).—These batteries shall have terminals and internal connections between cells complying with the requirements for radio *B* batteries in section XI(f).

(d) *Flashlight cells* (table 4).—The metal cap on the carbon rod, and the zinc bottom, of flashlight cells or unit-cell flashlight batteries, serve as the terminals, and they shall be clean to insure good electrical contact.

(e) *Lantern batteries* (table 4).—The connections between cells of lantern batteries shall be soldered and the terminals shall be of spring

brass brought through the cover at the top. The point of contact of one terminal shall be at the center and that of the other 1 inch from it.

(f) *Radio batteries* (table 6).—These batteries shall have soldered connections between the individual cells. The battery terminals shall be spring clips or of the knurled-nut-and-screw type (thread 8–32). They shall be of brass or equally suitable metal. The negative terminal shall be marked by a minus sign (—) and each positive or intermediate terminal with a plus sign (+) and the nominal voltage. When wire terminals are required and specified, they shall consist of flexible tinned copper conductor equivalent to no. 18 (AWG) rubber-insulated and covered with single cotton braid. The positive terminal shall have a red braid and the negative terminal a black braid. Wire leads shall be 6 inches long. If batteries are waterproofed, the waterproofing material shall not be allowed to cover the terminals.

A terminal arrangement known as the "plug-in" type may be supplied at the manufacturer's option in lieu of the terminals specified in the preceding paragraph unless the purchaser specifies to the contrary. The "plug-in" terminals shall consist of a receptacle with the appropriate number of sockets conforming in arrangement and dimensions with the specifications of the Radio Manufacturers Association. An adaptor to fit the receptacle and having spring or screw terminals shall be made available by the manufacturer. Adaptor shall make good electrical contact in the receptacle.

(g) *Radio C batteries* (table 7).—These batteries shall have soldered connections between the individual cells. The terminals shall be the same as described in section (f) for *B* batteries, except for the marking which shall be as follows: The positive terminal shall be marked with a plus sign (+) and each negative or intermediate terminal with a minus sign (—) and the nominal voltage. Wire terminals on *C* batteries shall conform to the same requirements as for *B* batteries in (f) above.

XII. VOLTAGE TESTS

(a) The voltage of individual cells shall be not less than the values shown in table 8 when measured with a voltmeter having a resistance of not less than 100 ohms per volt and having not less than 50 divisions of its scale per volt.

(b) The voltage of batteries of two or more cells shall be not less than the product of the required minimum voltage per cell by the number of cells in series in the battery. The voltage of cells and batteries other than *B* and *C* batteries shall be measured with a voltmeter having a resistance of not less than 100 ohms per volt and a scale having at least 100 divisions. The voltage of radio batteries for the plate (*B*) circuit and for the grid (*C*) circuit shall be measured with a voltmeter having not less than 1,000 ohms resistance per volt and a scale having not less than 100 divisions.

(c) Voltage tests are intended to apply to fresh cells or batteries and shall be made within 30 days of receipt of samples by the testing agency.

XIII. CAPACITY TESTS

(a) The size and kind of dry cell or battery and the conditions of service determine the kind of test to be applied. The test which best represents any particular service is that which most nearly duplicates

the rate of energy output of the battery when in actual use. Intermittent tests are preferred to continuous tests and shall be used wherever possible, since there is no direct relation between the results of continuous tests and intermittent tests of longer duration.

"Initial" tests intended to show the condition of fresh batteries shall be started within 30 days of the receipt of the batteries by the testing agency. All tests not otherwise designated shall be understood to be "initial" tests.

"Delayed" service tests are intended to measure the keeping quality of cells and batteries before use. Cells and batteries for delayed test shall have been stored on open circuit at an even temperature of 21° C (70° F) for the period of time specified, before being subjected to the procedure for the test specified in the table of requirements under section XIV.

TABLE 8

Cell designation	Minimum voltage	Cell designation	Minimum voltage
	Volts		*Volts*
AAA	1.47	*D*	1.50
AA	1.47	*E*	1.50
A	1.47	*F*	1.50
B	1.48	*G*	1.50
C	1.49	No. 6	1.50
CD	1.50		

The standard temperature for tests is 21° C (70° F), unless otherwise specified. Deviations from this temperature shall be stated.

The resistance of the discharge circuit shall be maintained within 0.5 percent of its nominal value.

To determine compliance with this specification, those tests shall be applied for which requirement figures are given in tables 9, 10, 11, 12, and 13.

In the tests described below the frequency of readings specified for each test relates to the larger and more commonly used sizes of cells and batteries. When the smaller sizes are tested, more frequent readings are required.

(b) *Description of tests.*—(1) *Light intermittent test.*—Three cells connected in series shall be discharged through 20-ohms resistance for 10 periods of 4 minutes each beginning at hourly intervals during 6 days per week. On the remaining day every other discharge period shall be omitted. (There are 65 such discharge periods per week, or a total weekly service of 260 minutes.)

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage of the battery; and closed-circuit voltage at the end of the tenth discharge of each succeeding fourteenth day.

The test shall be continued until the closed-circuit voltage of the battery falls below 2.8 volts. The service shall be reported as the total number of days on test to 2.8 volts.

(2) *Fifty-ohm telephone test.*—This test shall be conducted exactly as called for in section (1) above except that the three cells shall be discharged through 50 instead of 20 ohms and the cut-off voltage shall be 3.25 instead of 2.8 volts.

(3) *Heavy intermittent test.*—The battery shall be discharged through a resistance of 2⅔ ohms for each cell in series for two periods of 1

hour each, daily. The interval between daily discharge periods shall be not less than 6 hours.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage of the battery; and closed-circuit voltage every alternate working day thereafter at the end of the second discharge period of the day.

The test shall be continued until the closed-circuit voltage of the battery falls below 0.85 volt per cell. The service shall be reported as the total number of hours on test to 0.85 volt per cell.

(4) *Flashlight 4-ohm continuous test.*—The cells and batteries shall be discharged continuously through a resistance of 4 ohms per cell.

The following readings shall be taken: Initial open-circuit voltage of the cell or battery; initial closed-circuit voltage of the cell or battery; and closed-circuit voltage at half-hour intervals until the voltage drops to 0.8 volt per cell, after which the readings shall be taken twice as often.

The test shall be continued until the closed-circuit voltage falls below 0.75 volt per cell. The service shall be reported as the number of minutes on test to 0.75 volt per cell.

(5) *House-flashlight intermittent test.*—The battery shall be discharged for 5-minute periods, at 24-hour intervals, through a resistance of 4 ohms for each cell in series in the battery.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage of the battery; and closed-circuit voltage of the battery at the end of a discharge period twice each week thereafter.

The test shall be continued until the closed-circuit voltage of the battery falls below 0.75 volt per cell. The service shall be reported as the total number of minutes on test to 0.75 volt per cell.

(6) *Light industrial flashlight test.*—The battery shall be discharged for 4-minute periods beginning at hourly intervals for 8 consecutive hours every day with 16-hour rest periods intervening, through a resistance of 4 ohms for each cell in series in the battery. (There are 8 such discharge periods each day or a total daily discharge of 32 minutes.)

The following readings shall be taken: Initital open-circuit voltage of the battery; initial closed-circuit voltage of the battery; and closed-circuit voltage of the battery daily at the end of the last discharge period.

The test shall be continued until the closed-circuit voltage of the battery falls below 0.90 volt per cell. The service shall be reported as the total number of minutes on test to 0.90 volt per cell.

(7) *Heavy industrial flashlight test.*—The battery shall be discharged for 4-minute periods, beginning at 15-minute intervals, for 8 consecutive hours every day, with 16-hour rest periods intervening, through a resistance of 4 ohms for each cell in series in the battery. (There are 32 such discharge periods each day or a total daily discharge of 128 minutes.)

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage of the battery; and closed-circuit voltage of the battery at the end of the sixteenth and thirty-second discharge periods daily.

The test shall be continued until the closed-circuit voltage of the battery falls below 0.90 volt per cell. The service shall be reported as the number of minutes of actual discharge to 0.90 volt per cell.

(8) *Railroad-lantern battery test.*—The battery shall be discharged every day during 8 periods of 30 minutes each, beginning at intervals of 1 hour for 8 consecutive hours, through a resistance of 8 ohms for each cell in series in the battery.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage of the battery; and closed-circuit voltage of the battery daily thereafter at the end of the last period of discharge for the day.

The test shall be continued until the closed-circuit voltage of the battery falls below 0.90 volt per cell. The service shall be reported as the total number of hours to 0.90 volt per cell.

(9) *Radio B 5,000-ohm intermittent test.*—Each 22½ volt (nominal voltage) battery unit shall be discharged through a resistance of 5,000 ohms during a continuous period of 4 hours daily, the intervals between successive discharge periods being not less than 16 hours.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage of the battery; and closed-circuit voltage readings at the end of alternate discharge periods.

The test shall be continued until the closed-circuit voltage falls below 17 volts. The service shall be reported as the total number of hours of actual discharge to 17 volts.

(10) *Radio B 1,250-ohm intermittent test.*—This test shall be as specified in paragraph XIII (b) (9) above with the exception that 1,250 ohms shall be used in place of 5,000 ohms.

(11) *Light hearing-aid test.*—The battery shall be discharged each day through a resistance of 15 ohms for each cell in series in the battery during 16 periods of 15 minutes each, alternating with 15-minute periods of rest, during 8 consecutive hours, with 16-hour rest periods intervening.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage of the battery; and closed-circuit voltage of the battery twice daily at the end of the eighth and sixteenth discharge periods of the day.

The test shall be continued until the closed-circuit voltage falls below 1.0 volt per cell. The service shall be reported as the total number of hours to 1.0 volt per cell.

(12) *Heavy hearing-aid test.*—The battery shall be discharged each day through a resistance of 12 ohms for each cell in series in the battery for one continuous period of 8 hours at a temperature of 90° F. Between periods of discharge the battery shall be removed from the 90° F temperature to a 70° F temperature for a 16-hour period of recuperation.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage of the battery; and closed-circuit voltage of the battery at 2-hour intervals during and at the end of each discharge period.

The test shall be continued until the closed-circuit voltage falls below 1.0 volt per cell. The service shall be reported as the total number of hours to 1.0 volt per cell.

(c) *Radio C battery tests.*—The C batteries shall be stored on open-circuit at an even temperature of approximately 21° C (70° F), and voltage readings shall be taken at intervals of not exceeding one month.

The test shall be continued until the open-circuit voltage falls below 1.45 volts per cell. The service shall be reported as the number of months to 1.45 volts per cell.

XIV. REQUIRED PERFORMANCE

(a) *No. 6 dry cells and sizes D and E telephone cells.*—

TABLE 9

Cell types	Light intermittent test	50-ohm telephone test	Heavy intermittent tests	
			Initial	6 months, delayed
	Days	*Days*	*Hours*	*Hours*
General purpose no. 6 [a] (includes radio *A* type)	200		70	55
Industrial no. 6 [b]	325	500	90	80
"Special" telephone no. 6	325	600	(c)	(c)
"Regular" telephone no. 6	260	470	(c)	(c)
Size *E*, telephone	40	75	(c)	(c)
Size *D*, telephone	25	45	(c)	(c)

[a] Cells not otherwise specifically marked or represented by the manufacturer shall be considered as general purpose cells and tested according to the requirements thereof.

[b] This type of cell is designed for applications where highly efficient performance is required on both heavy and light services.

[c] No requirements are shown for telephone cells on heavy intermittent test as these types are not usually designed for heavy service.

(b) *Group batteries of small cells.*—Group batteries of small cells intended as equivalent to no. 6 dry cells shall meet the requirements shown in table 9 for the corresponding type of no. 6 cell.

(c) *Flashlight cells and batteries.*—

TABLE 10

Cell		Flashlight continuous test	Household intermittent tests	
Designation	Type		Initial	6 months, delayed
		Minutes	*Minutes*	*Minutes*
AA	General purpose		55	40
A	do		75	55
B	do		175	135
C	do		270	225
D	do	380	550	500

Cell		Heavy industrial tests		Light industrial tests		Railroad lantern tests	
Designation	Type	Initial	3 months, delayed	Initial	3 months, delayed	Initial	3 months, delayed
		Minutes	*Minutes*	*Minutes*	*Minutes*	*Hours*	*Hours*
D	Heavy industrial	600	500				
D	Light industrial			750	675		
F	Railroad lantern					35	30

(d) *Hearing-aid batteries.*—

TABLE 11

Cell designation	Heavy hearing-aid test	Light hearing-aid test
	Hours	*Hours*
B	5½	7½
C	9	12
CD	30	40

(e) *Radio B batteries.*—

TABLE 12

Cell designation	5,000-ohm intermittent tests		1,250-ohm intermittent tests	
	Initial	6 months, delayed	Initial	6 months, delayed
	Hours	*Hours*	*Hours*	*Hours*
AAA	45			
AA	100			
A	175	150		
B	325	275		
D			250	200
F			450	375
G			600	500

(f) *Radio C batteries.*—

TABLE 13

Cell designation	*C* battery test
	Months
B	12
D	18

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