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NATIONAL BUREAU OF STANDARDS
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Electric Batteries and Standard Cells
Publications by the Staff of the National Bureau
of Standards and references to other sources
of information

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General Information

Some of the publications in this list have appeared in the regular series of publications of the Bureau and others in various scientific and technical journals. Unless specifically stated, papers are not obtainable from the National Bureau of Standards.

Where the price is stated, the publication can be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The prices quoted are for delivery to addresses in the United States and its territories and possessions and in certain foreign countries which extend the franking privilege. In the case of all other countries, one-third of the cost of the publication should be added to cover postage. Remittances should be made either by coupons (obtainable from the Superintendent of Documents in sets of 20 for \$1.00 and good until used), or by check or money order payable to the "Superintendent of Documents, Government Printing Office" and sent to him with order.

Publications marked "OP" are out of print, but, in general, may be consulted at technical libraries.

For papers in other scientific or technical journals, the name of the journal or of the organization publishing the article is given in abbreviated form, together with the volume number (underscored), page, and year of publication in the order named. The Bureau cannot supply copies of such journals nor reprints from them, and it is unable to furnish information as to their availability or price. They, too, can usually be consulted at technical libraries.

Series letters with serial numbers are used to designate Bureau publications.

S - "Scientific Paper." S1 to S329 are "Reprints" from the "Bulletin of the Bureau of Standards." S330 to S572 were published as "Scientific Papers of the Bureau of Standards." This series was superseded by the "Bureau of Standards Journal of Research" in 1928.

T - "Technologic Paper." T1 to T370. This series was superseded by the "Bureau of Standards Journal of Research" in 1928.

RP - "Research Paper." These are reprints of articles appearing in the "Bureau of Standards Journal of Research" and the "Journal of Research of the National Bureau of Standards." The latter is the title of this periodical since July 1934 (volume 13, number 1).

C - "Circular."

Federal Specifications relating to dry cells and storage batteries, are listed under the symbols W-B, C-A and GG-H. These specifications have been approved by the Director of Procurement, Treasury Department, and are a part of the Federal Standard Stock Catalogue.

Circular C24 and supplements, the complete list of the Bureau's publications (1901-1944), is sold by the Superintendent of Documents for \$1.30. Announcement of new publications is made each month in the Technical News Bulletin which is obtainable by subscription at one dollar a year (\$1.35 foreign).

Dry Cells

<u>Title</u>	<u>Series</u>	<u>Price</u>
Electrical characteristics and testing of dry cells. (2nd ed.) (1923)	C79	OP*
Relation of voltage of dry cells to the hydrogen-ion concentration. H.D. Holler and L.M. Ritchie. Sci.Paper BS <u>15</u> , 659 (1919-1920)	S364	OP
Automatic apparatus for intermittent testing. G.W. Vinal and L.M. Ritchie (1920)	T171	OP
Electromotive force of cells at low temperatures. G.W. Vinal and F.W. Altrup. Sci. Paper BS <u>17</u> , 627 (1922)	S434	5c
American Standard Specification for dry cells and batteries. (1941)	C435	10c
Government specifications for dry cells. G.W. Vinal. Commercial Standards Monthly (Nat'l. Bureau of Standards, Wash., D.C.) <u>7</u> , 35 (1930)		OP
Batteries and cells, dry. Federal Standard Stock Catalogue, Specification Symbol W-B-101a (May 7, 1935) and Amendment No. 1 (Nov. 1935). Being revised.	W-B-101a	5c
Low temperature dry cells. E. Otto, C.K. Morehouse and G.W. Vinal. Trans. Electrochemical Soc. (Electrochemical Society, Inc., New York, N.Y.) <u>90</u> , (1946), Preprint 90-17.		
Service life of and gases evolved from dry batteries stored at 130°F. W.J. Hamer, J.P. Schrodt and G.W. Vinal. Trans. Electrochemical Soc. (Electrochemical Society, Inc., New York, N.Y.) <u>90</u> , (1946), Preprint 90-30.		

*Pending the revision of Circular 79, which is now out of print, copies of Letter Circular No. 677, entitled, "Electrical Characteristics of Dry Cells and Batteries" can be obtained on application to the National Bureau of Standards. No charge is made for this letter circular.

<u>Title</u>	<u>Series</u>	<u>Price</u>
A study of equilibrium reactions in the Leclanche dry cell. H.F. McMurdie, D.N. Craig and G.W. Vinal. Trans. Electrochemical Soc. (Electrochemical Society, Inc., New York, N.Y.) <u>90</u> , (1946), Preprint 90-31.		
Electrical characteristics of dry cells. G.W. Vinal and L.M. Ritchie. Chem. and Met. Eng. (McGraw-Hill Publishing Co., New York, N.Y.) <u>27</u> , 546 & 603 (1922).		
ASA Committee keeps standard on dry cells up-to-date. G.W. Vinal. Industrial Standardization (American Standards Association, 70 East 45th Street, New York) <u>8</u> , 49 (1937).		

Storage Batteries

Cadmium electrode for storage-battery testing. H.D. Foller and J.M. Braham (1919)	T146	OP
Estimation of nitrates and nitrites in battery acid. L.B. Sefton. (1920)	T149	OP
Operation and care of vehicle-type batteries. (1920)	C92	OP
Oscillograph measurements of current and voltage in the battery circuit of automobiles. G.W. Vinal and C.L. Snyder (1921)	T186	OP
A new method for determining the rate of sulphation of storage-battery plates. G.W. Vinal and L.M. Ritchie. (1922)	T225	OP
Electromotive force of cells at low temperatures. G.W. Vinal and F.W. Altrup. Sci. Pap. BS <u>17</u> , 627 (1922)	S434	5c
Measurement of electrical resistance and mechanical strength of storage battery separators. C.L. Snyder. Tech. Pap. BS <u>18</u> , 619 (1924-1925)	T271	OP
Storage batteries, ignition, lighting and starting. Federal Standard Stock Catalogue, Specification Symbol W-B-131b, 1939	W-B-131b	5c
Determination of small quantities of volatile organic acids in sulphuric-acid solutions. D.N. Craig. BS J. Research <u>6</u> , 169 (1931)	RP267	5c
Viscosity of sulphuric acid solutions used for battery electrolytes. G.W. Vinal and D.N. Craig. BS J. Research <u>10</u> , 781 (1933)	RP566	5c

<u>Title</u>	<u>Series</u>	<u>Price</u>
Composition of grids for positive plates of storage batteries as a factor influencing the sulphation of negative plates. G.W. Vinal, D.N. Craig and C.L. Snyder. <u>ES J. Research</u> <u>10</u> , 795 (1933)	EP567	5c
Resistivity of sulphuric-acid solutions and its relation to viscosity and temperature. G.W. Vinal and D.N. Craig. <u>J. Research NBS</u> <u>13</u> , 689 (1934)	RP738	5c
Chemical reactions in the lead storage battery. G.W. Vinal and D.N. Craig. <u>J. Research NBS</u> <u>14</u> , 449 (1935)	RP778	OP
Acid, sulphuric, (for) storage batteries. Federal Standard Stock Catalogue, Specification symbol OA 111, 1935 (December 18, 1935)	OA111	5c
Solubility of lead sulphate in solutions of sulphuric acid, determined by dithizone with photronic cell. D.N. Craig and G.W. Vinal. <u>J. Research NBS</u> <u>22</u> , 55 (1939)	RP1165	5c
Hydrometers, Syringe (for lead-acid storage batteries) Federal Standard Stock Catalogue, Specification Symbol GG-H-941, 1940 (March 7, 1940)	GG-H-941	5c
Thermodynamic properties of sulfuric-acid solutions and their relation to the electromotive force and heat of reaction of the lead storage battery. D.N. Craig and G.W. Vinal. <u>J. Research NBS</u> <u>24</u> , 473 (1940)	RP1294	5c
Note on the effect of Cobalt and Nickel in Storage Batteries. G.W. Vinal, D.N. Craig and C.L. Snyder. <u>J. Research NBS</u> <u>25</u> , 417 (1940)	RP1335	5c
Storage battery electrolytes. G.W. Vinal and G.N. Schramm. <u>Trans. Am. Inst. Elec. Eng.</u> (Am. Inst. Elec. Engineers, New York, N.Y.), <u>44</u> , 288 (1925)		
Storage batteries. G.W. Vinal, (John Wiley and Sons, New York, N.Y.) 3rd ed. 1940 (a book, 464 pages, see entry on page 8 of this circular.)		
Storage batteries. G.W. Vinal. <u>J. Opt. Soc. and Rev. Sci. Instruments.</u> (Ithaca, N.Y.), <u>11</u> , 263 (1925).		
Effect of temperature and other factors on the performance of storage batteries. G.W. Vinal and C.L. Snyder. <u>Trans. Am. Electrochemical Soc.</u> (Am. Electrochemical Soc., New York, N.Y.), <u>53</u> , 233 (1928).		

Standard Cells and Potential Measurements

<u>Title</u>	<u>Series</u>	<u>Price</u>
Preliminary specifications for Clark and Weston cells. F.A. Wolff and C.E. Waters. Bul. BS <u>3</u> , 623 (1907)	S67	OP
Clark and Weston standard cells. F.A. Wolff and C.E. Waters. Bul. BS <u>4</u> , 1 (1907)	S70	OP
The electrode equilibrium of the standard cell. F.A. Wolff and C.E. Waters. Bul. BS <u>4</u> , 81 (1907-1908)	S71	OP
Temperature formula of the Weston standard cell. F.A. Wolff. Bul. BS <u>5</u> , 309 (1908-1909)	S104	OP
Announcement of a change in the value of the international volt. (1910)	C29	OP
The two common failures of the Clark standard cell. M.P. Shoemaker and E.C. McKelvy. Sci. Pap. BS <u>16</u> , 409 (1920)	S390	OP
A method of studying electrode potentials and polarization. H.D. Holler. Sci.Pap. PS <u>20</u> , 153 (1924-1926)	S504	OP
International comparison of electrical standards. G.W. Vinal. BS J Research <u>8</u> , 729 (1932)	RP448	5c
Effect of service temperature conditions on the electromotive force of unsaturated portable standard cells. (J.H. Park. BS J. Research <u>10</u> , 89 (1933)	RP518	5c
A temperature controlled box for saturated standard cells. E.F. Mueller and H.F. Stimson. J. Research NBS <u>13</u> , 699 (1934)	RP739	5c
Effect of glass containers on electromotive force of Weston normal cells. G.W. Vinal and M.L. Howard. BS J. Research <u>11</u> , 255 (1933)	RP588	5c
Solubility of mercurous sulphate in sulphuric-acid solutions. D.N. Craig and G.W. Vinal and F.E. Vinal. J. Research NBS <u>17</u> , 709 (1936)	RP939	5c
Electromotive force of saturated Weston standard cells containing deuterium oxide. L.H. Erickwedde and G.W. Vinal. J. Research NBS <u>20</u> , 599 (1938)	RP1094	5c

<u>Title</u>	<u>Series</u>	<u>Price</u>
Metastability of cadmium sulfate and its effect on electromotive force of saturated standard cells. G.W. Vinal and L.H. Brickwedde. J. Research NBS <u>26</u> , 455 (1941)	RP1389	5c
Relation of electromotive force to the concentration of deuterium oxide in saturated standard cells. L.H. Brickwedde and G.W. Vinal. J. Research NBS <u>27</u> , 479 (1941)	RP1435	5c
Solubility of cadmium sulfate in H ₂ O - D ₂ O mixtures, Langhorne H. Brickwedde. J. Research NBS <u>36</u> , 377 (1946)	RP1707	5c
Maintenance of the volt. G.W. Vinal. Trans. Am. Electrochemical Soc. (Am. Electrochemical Soc., New York, N.Y.) <u>54</u> , 247 (1928)		
Units of electrical measurement. G.W. Vinal. Trans. Am. Electrochemical Soc. (Am. Electrochemical Soc., New York, N.Y.) <u>55</u> , 43 (1929)		
The definition of polarization, overvoltage and decomposition potential. W. Blum and G.W. Vinal. Trans. Electrochemical Soc. (Electrochemical Soc. Inc., New York, N.Y.) <u>66</u> , 359 (1934)		
Standards of electromotive force. G.W. Vinal, D.N. Craig and L.H. Brickwedde. Trans. Electrochemical Soc. (Electrochemical Society, Inc., New York, N.Y.) <u>68</u> , 139 (1935).		

Other Types of Batteries

Characteristics of a silver peroxide-zinc primary cell. I.A. Denison. Trans. Electrochemical Soc. (Electrochemical Society, Inc., New York, N.Y.) <u>90</u> , (1946), Preprint 90-26.		
A lead dioxide cell containing various electrolytes. J.P. Schrodtt, W.J. Otting, J.O. Schoegler and D.N. Craig, Trans. Electrochemical Soc. (Electrochemical Society, Inc., New York, N.Y.) <u>90</u> , (1946), Preprint 90-21.		

Rectifiers

Theory and Performance of rectifiers. H.D. Holler and J.P. Schrodtt. Tech. Paper BS, <u>18</u> , 465, (1924-1925)	T265	OP
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REFERENCES TO BOOKS AND SPECIFICATIONS ON BATTERY SUBJECTS

The National Bureau of Standards receives frequent inquiries regarding manufacturing processes and requests for other information which is not specifically covered in its publications. To meet the needs of such inquiries a very brief list of recent books relating to primary batteries and storage batteries is given below with a brief statement of the scope of the book and the name of the author and publisher. Specifications issued by Engineering Societies are listed in Section (c) below.

(a) Primary Batteries

Primary batteries. W.R. Cooper. (D. Van Nostrand Co., New York, N.Y.) 2nd ed. 1917. Theory, construction and use of the various forms of primary batteries.

(b) Storage Batteries

Storage batteries. G.W. Vinal. (John Wiley & Sons, New York, N.Y.) 3rd ed. 1940. Describes manufacturing processes, properties of the electrolyte, theory of reactions, operating characteristics, and testing. Uses for storage batteries are discussed.

Alkaline accumulators. J.T. Crennell and F.M. Lea. (Longmans Green and Co., New York, N.Y.) 1928. Development, construction and manufacture of alkaline storage batteries including several types. Electrochemical theory, electrical characteristics, operation, maintenance, and applications.

Storage batteries. Morton Arendt. (D. Van Nostrand Co. Inc., New York, N.Y.) 1928. A general book on the subject, describing manufacture, assembly, upkeep and care of batteries.

(c) Specifications

(For specifications published by the Government see pages 3, 4 and 5.)

Standards for storage batteries. No. 36, February 1928 (American Institute of Electrical Engineers, 33 West 39th Street, New York, N.Y.) Approved as American Standard by the American Standards Association, C-40-1928, October 1928.

S.A. E. Standard for storage batteries (Automotive types) approved January 1938 (Society of Automotive Engineers) 29 West 39th Street, New York, N.Y.)