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Letter
Circular
LC-904
(Supersedes
LC-846)

UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON 25, D. C.
May 10, 1948

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

Contents

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 "CP" 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 This series was superseded by the "Bureau of Standards Journal of Research" in 1928.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 This series was superseded by the "Bureau of Standards Journal of Research" in 1928.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, O-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 $1.40. Announcement of new publications is made each month in the Technical News Bulletin which is obtainable by subscription at $1.00 a year in the United States, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama, other countries at $1.35.

Dry Cells

Title	Series	Price
Electrical characteristics and testing of dry cells. (2nd ed.) (1923)	C79	OP*
*Pending the revision of Circular 79, which is now out of print, copies of Letter Circular No. 877 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.		
Relation of voltage of dry cells to the hydrogen-ion concentration. H.D. Holler and L.M. Ritchie. Sci. Paper BS 15, 659, (1919-1920). Superseded by paper on equilibrium reactions noted below.	S364	OP
Electromotive force of cells at low temperatures. G.W. Vinal and F.W. Altrup. Sci. Paper BS 17, 627 (1922)	S434	OP
American Standard Specification for dry cells and batteries. C18-1947.	C466	10c
Government specifications for dry cells. G.W. Vinal. Commercial Standards Monthly (Natl. Bureau of Standards, Wash., D.C.) 7, 35 (1930)		OP
Batteries and cells, dry. Federal Standard Stock Catalogue, Specification Symbol W-B-101b (Feb. 19, 1948)	W-B-101b	10c
An Improved Method for Measurement of gel strenght and data on starch gels. Walter J. Hamer J. Research NBS 39, 29 (1947)	RP1810	10c
Correlations of the gel strength of paste walls and the shelf life of electric dry cells. Walter J. Hamer. J. Research NBS 40, 251 (1948)	RP1870	15c
Effect of inhibitors on the corrosion of zinc in dry-cell electrolytes. Clarence K. Morehouse, Walter J. Hamer and George W. Vinal. J. Research NBS 40, 151 (1948)	RP1863	10c
Microscopic and diffraction studies on dry cells and their raw materials. Howard F. McMurdie. Trans. Electrochem. Soc. 86, 313 (1944) Electrochemical Society, Inc. New York, N.Y.)		

Title	Series	Price
Effect of digesting, autoclaving and neutralizing some battery manganese dioxides. Earl Otto, G.W. Vinal and Elinor H. Ostrander. Trans. Electrochem. Soc. 86, 327 (1944). (Electrochemical Society, Inc. New York, N.Y.)		
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.) 90, 509 (1946)		
Low temperature dry cells. E. Otto, C.K. Morehouse and G.W. Vinal. Trans. Electrochemical Soc. (Electrochemical Society, Inc., New York, N.Y.) 90, 419 (1946)		
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.) 90, 449 (1946).		
Improvements in service mirrored in 1947 dry cell standard. G.W. Vinal. Industrial Standardization 18, 277 (1947). (Am. Standards Assoc., New York, N.Y)		
Storage Batteries		
Cadmium electrode for storage-battery testing. H.D. Holler 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 17, 627 (1922)	S434	OP
Measurement of electrical resistance and mechanical strength of storage battery separators. C.L. Snyder. Tech. Pap. BS 18, 619 (1924-1925)	T271	OP

Title	Series	Price
Storage batteries, ignition, lighting and starting. Federal Standard Stock Catalogue, Specification Symbol W-B-131b, 1939 (being revised).	W-B-131b	5c
Determination of small quantities of volatile organic acids in sulphuric-acid solutions. D.N. Craig. BS J. Research 6, 169 (1931)	RP267	5c
Viscosity of sulphuric acid solutions used for battery electrolytes. G.W. Vinal and D.N. Craig. BS J. Research 10, 781 (1933)	RP566	5c
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. BS J. Research 10, 795 (1933)	RP567	OP
Resistivity of sulphuric-acid solutions and its relation to viscosity and temperature. G.W. Vinal and D.N. Craig. J. Research NBS 13, 689 (1934)	RP738	5c
Chemical reactions in the lead storage battery. G.W. Vinal and D.N. Craig. J. Research NBS 14, 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. J. Research NBS 22, 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. J. Research NBS 24, 473 (1940)	RP1294	5c

Title	Series	Price
Note on the effect of Cobalt and Nickel in storage batteries. G.W. Vinal, D.N. Craig and C.L. Snyder. J. Research NBS 25, 417 (1940)	RP1335	OP
Storage battery electrolytes. G.W. Vinal and G.N. Schramm. Trans. Am. Inst. Elec. Eng. (Am. Inst. Elec. Engineers, New York, N.Y.), 44. 288 (1925).		
Storage batteries. G.W. Vinal. J. Opt. Soc. and Rev. Sci. Instruments. (Ithaca, N.Y.), 11, 263 (1925)		
Effect of temperature and other factors on the performance of storage batteries. G.W. Vinal and C.L. Snyder. Trans. Am. Electrochemical Soc. (Am. Electrochemical Soc., New York, N.Y.), 53, 233 (1928).		
The Thermodynamics of aqueous sulfuric acid solutions from electromotive force measurements. Herbert S. Harned and Walter J. Hamer. J. Am. Chem. Soc., 57, 27 (1935)		
The molal electrode potentials and the reversible electromotive forces of the lead accumulator from 0 to 60° Centigrade. H.S. Harned and W.J. Hamer. J. Am. Chem. Soc. 57, 33 (1935).		
Temperature variation in transference numbers of concentrated solutions of sulfuric acid as determined by the galvanic cell method. Walter J. Hamer. J. Am. Chem. Soc. 57, 662 (1935).		
The ionization constant and heat of ionization of the bisulfate ion from electromotive force measurements. W.J. Hamer. J. Am. Chem. Soc. 56, 860 (1934).		
The potential of the lead dioxide-lead sulfate electrode at various temperatures. W.J. Hamer. J. Am. Chem. Soc. 57, 9 (1935)		
Storage batteries. G.W. Vinal, (John Wiley and Sons, New York, N.Y.) 3rd ed. 1940 (a book, 464 pages, see entry on page 10 of this circular.)		

Standard Cells and Potential Measurements

Title	Series	Price
Preliminary specifications for Clark and Weston Cells. F.A. Wolff and C.E. Waters. Bul. BS 3, 623 (1907)	S67	OP
Clark and Weston standard cells. F.A. Wolff and C.E. Waters. Bul. BS 4, 1 (1907)	S70	OP
The electrode equilibrium of the standard cell. F.A. Wolff and C.E. Waters. Bul. BS 4, 81 (1907-1908)	S71	OP
Temperature formula of the Weston standard cell. F.A. Wolff. Bul. BS 5, 309 (1908-1909)	S104	OP
Announcement of a change in the value of the international volt. (1910) (obsolete)	C29	OP
The two common failures of the Clark standard cell. M.P. Shoemaker and E.C. McKelvy. Sci. Pap. BS 16, 409 (1920)	S390	OP
A method of studying electrode potentials and and polarization. H.D. Holler. Sci. Pap. BS 20, 153 (1924-1926)	S504	OP
International comparison of electrical standards. G.W. Vinal. BS J. Research 8, 729 (1932)	RP448	5c
Effect of service temperature conditions on the electromotive force of unsaturated portable standard cells. (J.H. Park. BS J. Research 10, 89 (1933)	RP518	5c
A temperature controlled box for saturated standard cells. E.F. Mueller and H.F. Stimson. J. Research NBS 13, 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 11, 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 17, 709 (1936)	RP939	5c
Electromotive force of saturated Weston standard cells containing deuterium oxide. L.H. Brickwedde and G.W. Vinal. J. Research NBS 20, 599 (1938)	RP1094	5c
Announcement of changes in electrical and photometric units (1947)	C459	5c

Title	Series	Price
Metastability of cadmium sulfate and its effect on electromotive force of saturated standard cells. G.W. Vinal and L.H. Brickwedde. J. Research NBS 26, 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 27, 479 (1941)	RP1435	5c
Solubility of cadmium sulfate in H_2O - D_2O mixtures, L.H. Brickwedde. J. Research NBS 36, 377 (1946)	RP1707	5c
Maintenance of the volt. G.W. Vinal. Trans. Am. Electrochemical Soc. (Am. Electrochemical Soc., New York, N.Y.) 54, 247 (1928)		
Units of electrical measurement. G.W. Vinal. Trans. Am. Electrochemical Soc. (Am. Electrochemical Soc., New York, N.Y.) 55, 43 (1929)		
The ionization constant of water and the dissociation of water in potassium chloride solutions from electromotive forces of cells without liquid junction. H.S. Harned and W.J. Hamer. J. Am. Chem. Soc. 55, 2194 (1933)		
The definition of polarization, overvoltage and decomposition potential. W.Blum and G.W. vinal. Trans. Electrochemical Soc. (Electrochemical Soc. Inc., New York, N.Y.) 66, 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.) 68, 139 (1935).		
Standard cells and the change from international to absolute electrical units. G.W. Vinal. Jour. Electrochem. Soc., 93, 95 (1948)		
Transition from international to absolute electrical units as it affects the physical chemist. G.W. Vinal. Chicago Meeting of American Chemical Society, Apr. 19, 1948. (to be published)		

Other Types of Batteries and General Papers

Title	Series	Price
Characteristics of a silver peroxide-zinc primary cell. I.A. Denison. Trans. Electrochemical Soc. (Electrochemical Society, Inc. New York, N.Y.) 90, 387 (1946)		
A lead dioxide cell containing various electrolytes. J.P. Schrodt, W.J. Otting. J.O. Schoegler and D.N. Craig. Trans. Electrochemical Soc. (Electrochemical Society, Inc. New York, N.Y.) 90, 449 (1946)		
Electrochemical sources of electric power, Part I. Electrical Engineering 67, 354 (1948). Part II, Electrical Engineering 67, 456 (1948) (Am. Institute of Electrical Engineers, New York, N.Y.)		
Investigations of cells with molten electrolytes. W.J. Hamer and J.P. Schrodt. Chicago meeting of Am. Chemical Society, April 19, 1948. (to be published)		

Rectifiers

Theory and Performance of rectifiers. H.D. Holler and J.P. Schrodt. Tech. Paper BS 18, 465 (1924-1925)	T265	OP

REFERENCES TO BOOKS AND SPECIFICATIONS ON BATTERY SUBJECTS

The National Bureau of Standards receives frequent inquiries regarding man ufacturing 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 E.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 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 1940 (Society of Automotive Engineers) 29 West 39th Street, New York, N.Y.