BURGESS

Engineering Manual

COMPLETE BATTERY DATA

FOR THE

DESIGN ENGINEER

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BURGESS BATTERY COMPANY
DIVISION OF SERVEL, INC.
FREEPORT, ILLINOIS, U.S.A.

INTRODUCTION

Burgess Battery Company has prepared this Manual for the Design Engineer to provide him with a handy reference guide to the selection of the correct dry battery for all types of battery-powered equipment. Complete information in compact form on the most popular and representative battery types is presented on the following pages. The Manual was created from our Company's extensive experience over the years working with design engineers and their special problems. It was conceived with the engineer and his needs in mind, so that, at the start of the design, proper space allowance, discharge conditions, terminal connections, and numerous other factors influencing the correct selection of one of today's modern dry batteries may be considered.

The discharge conditions and battery types outlined in this Manual may be used to select power supplies for most applications; however, we anticipate occasional unusual conditions and special requirements and urge designers to contact our Engineering Department for assistance with application situations not covered by the Manual.

It has been a Burgess policy since the start of the company to cooperate with engineers in designing and producing unusual or special battery types. Constant research to find better ways to build better battery products has been characteristic of our operations and has resulted in major contributions to the science of electrochemistry. Our facilities and specialized skills enable us to offer the widest selection of dry batteries in America. Our research staff and testing laboratories are at the disposal of industry and the military in solving battery problems.

The modern technology of dry batteries has broadened the concept of service that industrial designers can expect from today's dry cells. This Manual is intended to bring the practical application of that technology to bear on today's design problems.

BURGESS BATTERY COMPANY

CONTENTS

Investigation of radioactive power for batteries is one of the many areas being studied by Burgess Battery Company engineers. This nucleonic laboratory is the latest of the modern laboratories operated by the Company to maintain its leadership in battery development.

Battery Arrangement

Batteries in this manual are arranged by groups according to battery voltage. Within each group the batteries are further arranged in order of increasing physical size.

The pictures at the top of each page permit quick identification of a particular battery. The tabulation below gives details of important battery features including size, weight, type of terminals, and voltage taps. Where details of the terminal arrangement are required these may be obtained by reference to the terminal sketch which is identified by number.

Selecting the Proper Battery for a Given Application

The starting point is normally the voltage required by using equipment. Reference to the group of batteries that will supply this voltage will show the various standard sizes available.

Next determine the initial drain in amperes or milliamperes that the battery will be required to furnish.

Estimate the operating time schedule, such as continuous service or daily service periods of 4 hours per day.

Determine the closed circuit end point voltage below which the equipment will not operate. This is normally in the range of 1.1 volts to 0.9 volt per 1.5 volt cell. In terms of a nominal 45 volt battery (which consists of thirty 1.5 volt cells in series) this end-point would be in the equivalent range of 33 to 27 volts.

Select a battery from the voltage group that appears to meet the requirements for size and weight. Refer to the service life graphs for this battery and, using the information previously assembled as to time schedule, drain, and end point, estimate the service life. Similar estimates should be made for larger and smaller batteries in the group. Final selection will then be based on the optimum balance of size, weight, and operating cost.

It will normally be advantageous to select the largest battery that can be accommodated in the equipment. This will usually result in lower cost per hour of operation and also in longer battery shelf life.

Estimating Battery Service Life

The last three columns of the tabulated battery data deal with service life. The first of these three lists the graph numbers where the service data may be found. The graphs show estimated service for continous discharge at 70° F. or for discharge of 4 hours per day at 70° F. The majority of service applications will fall under one or the other of these time schedules. All graphs are shown in terms of a single 1½ volt cell.

Many batteries are constructed of 2 or more cells in parallel and a number of these groups in series. The next two columns take this into consideration so that the graph data, which are in terms of a single cell, may be converted to apply to a given battery. The following example illustrates how this is done.

Estimating Battery Service Life (Continued)

Problem: How many hours of continuous service will be obtained at 70° F. from 6 volt 4F4H battery under the following conditions?
Initial Drain of using equipment — 0.20 amperes.
Closed circuit end point voltage below which the equipment will not operate — 4.4 volts.

Answer: (1) Refer to tabulation for 4F4H battery. The next to last column indicates that the drain of the using equipment should be divided by 4. (Battery made of groups of 4 cells in parallel).

$$\frac{0.20 \text{ amp}}{4} = 50 \text{ milliamperes initial drain per cell.}$$

(2) The last column of the tabulation indicates that the volts per cell as shown on the graph should be multiplied by 4. (Battery contains four 1½ volt cell groups in series). Since the battery end voltage is specified as 4.4 volts this is equal to 1.1 volts per cell on the graph.

$$\frac{4.4 \text{ volts}}{4 \text{ cell groups}} = 1.1 \text{ volts per cell}$$

(3) The tabulation for 4F4H battery lists graphs 50 and 51. Graph number 50 is for continuous service at 70° F. At an initial drain of 50 milliamperes per cell the estimated service life to 1.1 volts is 120 hours which is the answer to the problem.

Burgess Engineering Service for Special Problems

The information in this manual will enable the equipment designer to select the proper batteries for many applications. When special discharge cycles or other special conditions occur consult the Engineering Department S, Burgess Battery Company, Freeport, Illinois, for battery recommendations.

Burgess Battery Company maintains a complete laboratory devoted to battery testing and battery design. Burgess Engineers have extensive data available to enable them to recommend the best battery for special problems.

The following information should be included with your inquiry:

(A) Nominal voltage.
(B) End point voltage — This is the closed circuit voltage below which the equipment will not operate. It is commonly in the range of 1.1 to 0.9 volts per 1.5 volt cell.
(C) Initial Drain — This is current in amperes or milliamperes that the battery must supply at full nominal battery voltage.
(D) Discharge Schedule — This should indicate the period or periods of time each day during which the battery must furnish current. Also list the desired battery life.
(E) Type of Load — such as fixed resistor, vacuum tube filament or vacuum tube plate supply.
(F) Give details of desired size, shape, weight and type of terminals preferred.
(G) Operating temperature and storage temperature.
(H) Storage period prior to use.

A convenient form for listing this information will be found on Page 107 of this manual.

BASIC INFORMATION ON DRY BATTERIES

Cell Components

Burgess dry batteries as discussed here are the types in which the electrodes are zinc and carbon. This combination produces a cell having nominal 1.5 volts. The term "dry" is used because the electrolyte is made "nonspillable" by combining it with an absorbent or gelatinous material such as starch. The cell may then be discharged in any position.

The zinc electrode (Negative) in Burgess cells is made from a special zinc alloy with controlled purity of 99.99%.

The carbon electrode (Positive) consists of a carbon rod or plate surrounded by a mixture of manganese dioxide, acetylene black, ammonium chloride, zinc chloride, chrome inhibitor, and water. This mixture serves as a depolarizing agent to prevent the formation of bubbles of hydrogen on the positive carbon electrode as discharge progresses. The effectiveness of the depolarizer depends on the type of manganese dioxide used. Natural manganese dioxide as obtained from the mine may be satisfactory for some applications. However, the most active forms are prepared artifically and result in greatly increased battery service life. Burgess manufactures its own manganese dioxide which is known as the gamma type. Our commercial product is used in governmental and civilian laboratories as a standard for this type material.

Burgess dry batteries are clean, safe, compact, and easily portable. They contain no poisonous or harmful ingredients and are safe for use in all applications such as portable radios, toys, and any electronic devices that might be carried about on the person.

Performance and Testing

Burgess Testing Laboratories are equipped to perform over 250 different types of tests used for batteries for the Armed Forces and approximately 30 tests standardized by American Standards Association. All scientific test equipment employed in conducting these tests exceeds government standards for accuracy in every case. All of these tests are performed on many samples in order to have a complete and accurate test record on every type of battery.

Hundreds of sample cells are taken from each day's manufacture for testing on control tests. Cells of that date are not released for production into batteries until these tests are completed. This insures the user that his Burgess battery will give dependable service.

The service obtained from a given cell will depend on several factors including current drain, discharge temperature, discharge time cycle, end point voltage, and storage prior to use.

Temperature plays an important part in dry cell service. Most dry batteries are designed to operate near 70° F. Prolonged exposure to temperatures much above 130° F. may cause the battery to fail suddenly. With this qualification it may be said that the higher the discharge temperature, the greater the energy output.

A reduction in discharge temperature reduces the energy output. If ordinary dry batteries have been stored at room temperature of about 70° F. and are then removed to a cold location of 0° F. or below, it will require several hours for battery temperature to drop significantly. During this period the battery will continue to operate, though at slightly lower voltage caused by the lower temperature. In many instances it may be possible to insulate or protect the battery to prevent rapid cooling. When this is done, near normal service may be obtained, depending only on how rapidly the battery is allowed to cool.

After prolonged exposure to 0° F. or slightly below, ordinary batteries will give very little service except on relatively light drains. After prolonged exposure to about -10° F. they will become useless even on light drains. Special types, using electrolyte designed for low temperature operation, must be used where batteries are to be stored and operated in this temperature range.

Service life at low temperatures is reduced because of retarded chemical action within the cell. Exposure to low temperatures will not damage dry cells. In fact, low temperature storage is extremely beneficial to shelf life. Batteries can be stored for years with little or no deterioration at temperatures near 0° F. When removed from low temperature storage the cells may be warmed to return them to their original condition.

High temperature storage is harmful to dry cells and serves to reduce their shelf life. This is due to accelerated chemical action and to loss of moisture from within the cell at higher temperatures. For this reason dry batteries should be stored in cool locations. Refrigerated storage is very beneficial as previously stated.

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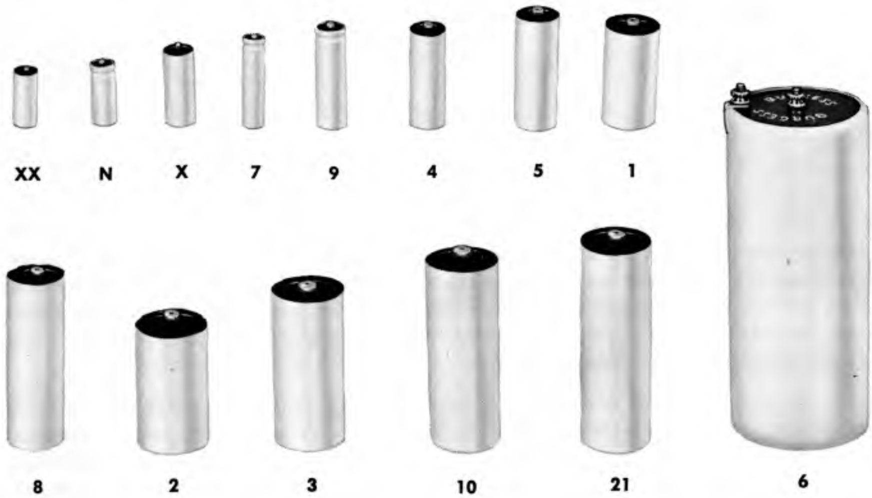
EXPLANATION OF VARIOUS CELL TYPES

Cell Types and Sizes

Dry cells are ordinarily made by three different types of construction. Each type has certain desirable characteristics that enable it to perform best on a given service. Burgess makes all three types, thus enabling Burgess Engineers to design each battery with the cell type that will insure highest performance.

(1) **Cylindrical Cells** — These are the familiar type such as used in flashlights. Due to the concentric relation of the electrodes, cylindrical cells are particularly suited for heavy drain service. The common sizes in which they are made are given in the following table.



CELL DESIGNATION		NOMINAL DIMENSIONS			
Burgess	**American Standards Association**	**Diameter (inches)**	**Height of Can (inches)**	**Approximate Volume (Cubic Inches)**	**Approximate Weight (Pounds)**
XX	N	27/64	1 1/64	0.14	0.014
N	N	7/16	1 3/32	0.16	0.013
X	R	17/32	1 3/8	0.31	0.025
7	AAA	25/64	1 11/16	0.20	0.016
9	AA	17/32	1 7/8	0.42	0.038
4	A	5/8	1 7/8	0.58	0.051
5	B	3/4	2 1/8	0.95	0.08
1	C	15/16	1 13/16	1.25	0.10
8	CD	1	3 3/16	2.4	0.20
2	D	1 1/4	2 1/4	2.7	0.19
3	E	1 1/4	2 7/8	3.5	0.25
10	F	1 1/4	3 7/16	4.2	0.33
21	G	1 1/4	3 13/16	4.7	0.36
6	6	2 1/2	6	29.3	1.7

(2) **Flat Type Cells** — Cells of this type are rectangular in shape. They provide more efficient utilization of space than the round cells. Their shape allows them to be packed tightly together, thus eliminating the waste space that occurs when cylindrical cells are used. They are made in the following common sizes.

N Z M D

CELL DESIGNATION		NOMINAL DIMENSIONS				
Burgess	American Standards Association	Length (inches)	Width (inches)	Thickness (inches)	Approximate Volume (Cubic Inches)	Approximate Weight (Pounds)
N	F40	1 1/4	27/32	0.21	0.217	0.015
Z	F70	2	1 1/4	0.22	0.55	0.044
M	F90	1 5/8	1 9/16	0.32	0.81	0.062
D	F100	2 13/32	1 13/16	0.42	1.83	0.15

(3) **Wafer Type Cells** — This new cell is rectangular in shape with the corners slightly rounded. It consists of a sandwich of artificial manganese dioxide mix between discs of flat zinc and carbon electrodes. The sandwich is wrapped in pliofilm envelopes and sealed. At this point the individual cells may be tested for quality control before they are assembled in series into units.

A spot of silver wax on the positive and negative sides of the cells provides perfect electrical contact between cells as they are stacked together, thus eliminating open circuit hazards of pin wire connectors or unreliable pressure contacts. The cell stack is then wrapped in Mylar film and is ready for packaging as a finished battery. Wafer cells are commonly made in the following sizes:

Y U K P N

CELL DESIGNATION		Nominal Dimensions of cells after folding in outer edge of pliofilm seal and assembly into units.				
Burgess	American Standards Association	Length (inches)	Width (inches)	Thickness (inches)	Approximate Volume (Cubic Inches)	Approximate Weight (Pounds)
Y	F15	9/16	9/16	0.125	0.032	0.0022
U	F20	15/16	17/32	0.117	0.055	0.0054
K	F30	1 1/4	27/32	0.13	0.134	0.009
P	F25	59/64	59/64	0.22	0.160	0.011
N	F40	1 1/4	27/32	0.21	0.217	0.014

PERFORMANCE ON STANDARD TESTS

Service Tests

Tests to duplicate special service conditions have been developed by a Sectional Committee of the American Standards Association acting under the sponsorship of the National Bureau of Standards. These tests are described in Bureau of Standards Circular #559. Some of the tests in common use may be summarized as follows:

Test Name	Daily Discharge Schedule	Resistance Per 1½ Volt Unit in Ohms	End Point per 1½ Volt Unit in Volts	Cell Size	ASA Initial Requirement	Typical Burgess Performance
General Purpose Flashlight to represent 0.5 amp. lamp.	1-5 Min. Period	2.25	0.65	D. Gen. Purpose	400 Min.	425 Min.
General Purpose Flashlight to represent 0.3 amp. lamp.	1-5 Min. Period	4	0.75	C AA	325 Min. 80 Min.	375 Min. 135 Min.
General Purpose Flashlight to represent 0.22 amp. lamp.	1-5 Min. Period	5	0.75	AAA	50 Min.	65 Min.
Heavy Industrial Flashlight to represent 0.3 amp. lamp.	32-4 Min. Periods	4	0.9	D Ind.	750 Min.	1050 Min.
Light Industrial Flashlight to represent 0.3 amp. lamp.	8-4 Min. Periods	4	0.9	D Gen. Purpose D Ind.	600 Min. 850 Min.	800 Min. 1100 Min.
Railroad Lantern to represent 0.15 amp. lamp.	8-½ Hr. Periods	8	0.9	F	45 Hrs.	55 Hrs.
Photoflash Test	60-1 Sec. Periods (1 discharge per minute for 1 hour per day)	0.15	0.5 D size. 0.25 C & AA sizes.	D Photo Flash C Photo Flash AA Photo Flash	800 Sec. 700 Sec. 150 Sec.	880 Sec. 750 Sec. 200 Sec.
Radio 'A'	1-4 Hour Period	25	1.0	F G	140 Hrs. 170 Hrs.	165 Hrs. 185 Hrs.
Radio 'B'	1-4 Hour Period	166⅔	1.0	F40 A F90	30 Hrs. 130 Hrs. 160 Hrs.	60 Hrs. 180 Hrs. 240 Hrs.
Heavy Intermittent	2-1 Hour Periods	2⅔	0.85	F (4 par) #6 Gen. Purpose #6 Ind.	70 Hrs. 70 Hrs. 100 Hrs.	72 Hrs. 75 Hrs. 110 Hrs.

BURGESS 1½ Volt Types
Single Cell

No. N No. NE No. 7 No. Z No. 920 No. 930 No. 1 No. 120 No. 130

No. 2* No. 210 No. 220 No. 230 No. 2R No. 8R No. 21R

PHYSICAL DESCRIPTION

Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAXIMUM DIMENSIONS INCHES		TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Diameter	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. By	Batt. Voltage Equals Volts Per Cell Times
N	1	N	0.013	0.438	1.17	Flash-light	1	–,+1½	13,14	1	1
NE	1	N	0.013	0.442	1.17	Flash-light	1	–,+1½	13,14	1	1
7	1	AAA	0.019	0.387	1.745	Flash-light	1	–,+1½	15,16	1	1
Z	1	AA	0.04	0.551	1.962	Flash-light	1	–,+1½	17,18	1	1
920	1	AA	0.04	0.551	1.962	Flash-light	1	–,+1½	19	1	1
930	1	AA	0.04	0.551	1.962	Flash-light	1	–,+1½	22,23	1	1
1	1	C	0.10	1.005	1.950	Flash-light	1	–,+1½	30,31	1	1
120	1	C	0.10	1.005	1.950	Flash-light	1	–,+1½	32	1	1
130	1	C	0.10	1.005	1.950	Flash-light	1	–,+1½	33,34	1	1
2*	1	D	0.2	1.322	2.406	Flash-light	1	–,+1½	37,38	1	1
210	1	D	0.22	1.322	2.406	Flash-light	1	–,+1½	42,43	1	1
220	1	D	0.19	1.322	2.406	Flash-light	1	–,+1½	39	1	1
230	1	D	0.2	1.322	2.406	Flash-light	1	–,+1½	40,41	1	1
2R	1	D	0.2	1.322	2.406	Flash-light	1	–,+1½	37,38	1	1
8R	1	CD	0.22	1.094	4.00	Socket	2	–,+1½	35,36	1	1
21R	1	G	0.38	1.322	4.145	Flash-light	1	–,+1½	54,55	1	1

*See Page 134 for example of product using this battery.

BURGESS 1½ Volt Types
(No. 6 and Multi-Cell)

No. 2D

No. 2F

No. 2FBP

No. 4F

No. 4FH

#6 Ignition

#6 Telephone

No. #6 Industrial

PHYSICAL DESCRIPTION

Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAXIMUM DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. By	Batt. Voltage Equals Volts Per Cell Times
2D	2	D	0.5	$2\frac{5}{8}$	$1\frac{11}{32}$	$3\frac{1}{32}$	Socket	2	–, +1½	37,38	2	1
2F	2	F	0.69	$2\frac{19}{32}$	$1\frac{3}{8}$	$4\frac{1}{4}$	Socket	2	–, +1½	50,51	2	1
2FBP	2	F	0.81	$2\frac{21}{32}$	$1\frac{3}{8}$	$4\frac{13}{32}$	Binding Post	3	–, +1½	50,51	2	1
4F	4	F	1.38	$2\frac{5}{8}$	$2\frac{5}{8}$	$4\frac{3}{32}$	Socket	2	–, +1½	50,51	4	1
4FH	4	F	1.25	$2\frac{5}{8}$	$2\frac{5}{8}$	$4\frac{5}{16}$	Binding Post	4	–, +1½	50,51	4	1
#6 Ign.	1	6	1.9	$2\frac{17}{32}$ Dia.		$6\frac{1}{2}$	Binding Post	5	–, +1½	56,57	1	1
#6 Tel.	1	6	1.9	$2\frac{17}{32}$ Dia.		$6\frac{5}{8}$	Spring Clip	6	–, +1½	60,61	1	1
#6 Ind.	1	6	2.0	$2\frac{17}{32}$ Dia.		$6\frac{1}{2}$	Binding Post	5	–, +1½	58,59	1	1

BURGESS 3 Volt Types

No. 422 | No. F2BP | No. 2F2H | No. 4F2H

PHYSICAL DESCRIPTION

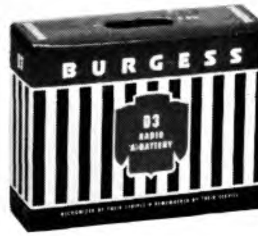
Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAXIMUM DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. By	Batt. Voltage Equals Volts Per Cell Times
422	2	A	0.13	$1\frac{11}{32}$	$\frac{23}{32}$	$2\frac{11}{16}$	Flat Strap	7	—, +3	24, 25	1	2
F2BP	2	F	0.82	$2\frac{21}{32}$	$1\frac{3}{8}$	$4\frac{15}{32}$	Binding Post	8	—, +3	50, 51	1	2
2F2H	4	F	1.5	$2\frac{5}{8}$	$2\frac{5}{8}$	$4\frac{13}{16}$	Binding Post	9	—, +3	50, 51	2	2
4F2H	8	F	2.82	$3\frac{7}{8}$	$2\frac{11}{16}$	$5\frac{13}{16}$	Spring Clip	10	—, +3	50, 51	4	2

BURGESS 4½ Volt Types

No. 532

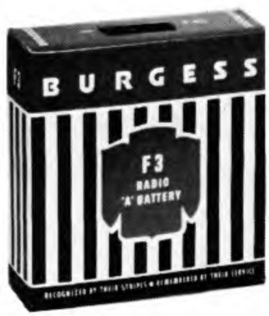
No. 5360

No. 2Z3



No. D3

No. 2370



No. F3

No. G3

PHYSICAL DESCRIPTION

Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAX. DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. by	Battery Voltage Equals Volts Per Cell Times
532	3	B	0.25	2 15/32	27/32	3 1/16	Flap Strap	11	–, +4½	26,27	1	3
5360	3	B	0.25	2 13/32	27/32	2 31/32	Binding Post	12	–, +4½	26,27	1	3
2Z3	6	F70	0.38	1 3/8	1 3/8	2 3/4	Small Snaps	70	–, +4½	62,63	2	3
D3	3	D	0.7	3 15/16	1 3/8	3	Socket	13	–, +4½	37,38	1	3
2370	3	D	0.7	3 15/16	1 3/8	3 1/8	Binding Post	14	+,–1½ –3,–4½	37,38	1	3
F3	3	F	1.12	4	1 7/16	4 1/8	Socket	13	–, +4½	50,51	1	3
G3	3	G	1.31	4	1 7/16	4 11/16	Socket	13	–, +4½	54,55	1	3

BURGESS 6 Volt Types

No. Z4 No. F4H No. F4PI **No. F4BP No. F4SC No. 4D4

No. TW1* No. 4F4H No. S461

Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAX. DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. by	Battery Voltage Equals Volts Per Cell Times
Z4	4	AA	0.14	$1\frac{3}{16}$	$1\frac{3}{16}$	$2\frac{21}{64}$	Flash-light	15	–, +6	22,23	1	4
F4H	4	F	1.5	$2\frac{5}{8}$	$2\frac{5}{8}$	$4\frac{3}{8}$	Coil Spring	16	–, +6	52,53	1	4
F4PI	4	F	1.5	$2\frac{21}{32}$	$2\frac{21}{32}$	$4\frac{1}{8}$	Socket	17	–, +6	50,51	1	4
F4BP	4	F	1.5	$2\frac{5}{8}$	$2\frac{5}{8}$	$4\frac{3}{16}$	Binding Post	18	–, +6	50,51	1	4
F4SC	4	F	1.5	$2\frac{5}{8}$	$2\frac{5}{8}$	$4\frac{1}{2}$	Spring Clip	71	–, +6	50,51	1	4
4D4	16	F100	2.5	$2\frac{9}{16}$	$2\frac{1}{32}$	$7\frac{3}{8}$	Large Snap	19	–, +6	48,49	4	4
TW1*	8	F	3.25	$5\frac{3}{8}$	$2\frac{7}{8}$	$4\frac{15}{16}$	Binding Post	20	–, +6	50,51	2	4
4F4H	16	F	6.5	$8\frac{5}{16}$	$2\frac{13}{16}$	$6\frac{7}{16}$	Binding Post	21	–, +6	50,51	4	4
S461	4	6	8.25	$10\frac{1}{2}$	$2\frac{3}{4}$	$7\frac{13}{16}$	Binding Post	22	–, +6	56,57	1	4

*See Page 134 for examples of products using this battery.

**Also available with spring clip.

BURGESS 7½ Volt Types

No. W5BP

No. 5540

No. C5

No. D5

No. 4F5H

PHYSICAL DESCRIPTION

Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAXIMUM DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. By	Batt. Voltage Equals Volts Per Cell Times
W5BP	5	N	0.16	2 31/32	23/32	1 25/32	Binding Post	23	+, −4½, −7½	13, 14	1	5
5540	5	B	0.50	3 15/16	7/8	3 1/16	5 B. Post 1 Wire	24	+, −1½, −3, −4½, −6, −7½	26, 27	1	5
C5	5	DC	0.69	2 5/32	1 15/16	3 1/32	Socket	25	−, +7½	44, 45	1	5
D5	5	DH	0.82	2 9/16	2	2 13/16	Large Snap	27	−, +7½	46, 47	1	5
4F5H	20	F	7.5	7¼	4 1/16	6⅜	Binding Post	26	−, +7½	50, 51	4	5

BURGESS 9 Volt Types

No. Y6

No. 2U6

No. P6

No. 2N6

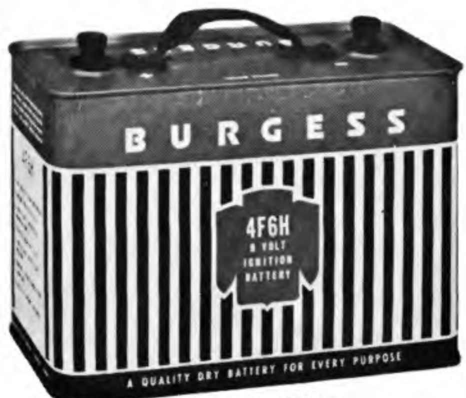
No. M6

No. C6X

No. D6

No. D6S

No. D6PI



No. 4F6H

PHYSICAL DESCRIPTION

Battery No. (In order of Increasing Physical Size)	Cells Used		Battery Weight in Pounds	MAX. DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. by	Battery Voltage Equals Volts Per Cell Times
Y6	6	YT	0.04	0.600	0.600	1.900	Small snap	72	—, +9	1,2	3	1
2U6	6	UT	0.06	1.010	0.605	1.880	Small snap	28	—, +9	64,65	1	6
P6	6	PT	0.13	1 (diam.)		1 15/16	Large snap	31	—, +9	9,10	1	6
2N6	6	F70	0.38	1 3/8	1 3/8	2 3/4	Small snap	29	—, +9	62,63	1	6
M6	6	F90	0.44	1 13/16	1 13/16	2 7/16	Large snap	68	—, +9	28,29	1	6
C6X	6	C	0.63	2 5/16	1 1/32	6 1/16	Large snap	30	—, +9	30,31	1	6
D6	6	F100	1.0	2 9/16	2	3 5/32	Large snap	32	—, +9	48,49	1	6
D6S	6	F100	1.19	2 1/4	1 1/4	7 29/32	Socket	73	—, +9	48,49	1	6
D6PI	6	D	1.38	7 29/32	2 21/32	1 1/2	Socket	33	—, +3, +6, +9	37,38	1	6
4F6H	24	F	9.25	8 9/16	4 1/16	6 17/32	Binding Post	34	—, +9	50,51	4	6

BURGESS 12, 13½ and 15 Volt Types

No. TW2* No. XX9 No. Y10 No. U10 No. K10

PHYSICAL DESCRIPTION

Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAXIMUM DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. By	Batt. Voltage Equals Volts Per Cell Times
TW2*	8	F	3.25	5 3/8	2 7/8	4 15/16	Binding Post	20	—, +12	50, 51	1	8
XX9	9	F40	0.19	1 21/64	1	2 11/16	Socket	35	—, +9 +13½	11, 12	1	9
Y10	10	F15	0.03	0.600	0.600	1.370	Flat Contact	36	—, +15	1, 2	1	10
U10	10	F20	0.05	1.010	0.605	1.423	Flat Contact	37	—, +15	3, 4	1	10
K10	10	F30	0.10	1¼	31/32	1 9/16	Flat Contact	38	—, +15	5, 6	1	10

*See Page 134 for example of product using this battery.

BURGESS 22½ Volt Types

No. Y15

No. U15

No. K15

No. XX15

No. 4156

No. 5156SC

PHYSICAL DESCRIPTION

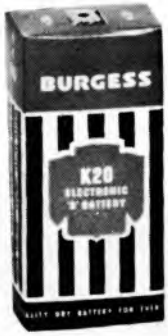
Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAXIMUM DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. By	Batt. Voltage Equals Volts Per Cell Times
Y15	15	F15	0.04	0.600	0.600	1.960	Recess-ed Flat Contact	39	—, +22½	1, 2	1	15
U15	15	F20	0.075	1.010	0.605	1.970	Flat Contact	37	—, +22½	3, 4	1	15
K15	15	F30	0.14	1¼	31/32	2 7/32	Flat Contact	38	—, +22½	5, 6	1	15
XX15	15	F40	0.25	1 11/32	15/16	3⅞	Socket	40	—, +22½	11, 12	1	15
4156	15	A	1.0	3 17/32	2⅛	2 15/16	Binding Post	41	—, +22½	24, 25	1	15
5156SC	15	B	1.38	4¼	2⅝	3¼	Spring Clip	42	+, —3, —4½, —6, —9, —10½ —16½, —22½	26, 27	1	15

BURGESS 30 Volt Types

No. Y20

No. Y20S

No. U20



No. K20

PHYSICAL DESCRIPTION

Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAXIMUM DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. By	Batt. Voltage Equals Volts Per Cell Times
Y20	20	F15	0.06	1.185	.593	1.420	Flat Contact	43	—, +30	1, 2	1	20
Y20S	20	F15	0.06	0.600	0.600	2.560	Flat Contact	36	—, +30	1, 2	1	20
U20	20	F20	0.09	1.010	0.605	2.532	Flat Contact	37	—, +30	3, 4	1	20
K20	20	F30	0.17	1¼	31/32	2 13/16	Flat Contact	38	—, +30	5, 6	1	20

BURGESS 45 Volt Types

No. U30 No. XX30 No. Z30 No. Z30NX No. M30 No. 5308 No. D30

No. 2308SC No. 10308SC No. 21308SC

PHYSICAL DESCRIPTION

Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAXIMUM DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. By	Batt. Voltage Equals Volts Per Cell Times
U30	30	F20	0.15	1 1/64	39/64	3 21/32	Small snap	44	—, +45	3, 4	1	30
XX30	30	F40	0.50	2 17/32	31/32	3¾	Large snap	45	—, +45	11, 12	1	30
Z30	30	F70	1.50	3	2 5/16	4 1/16	Socket	46	—, +22½ +45	20, 21	1	30
Z30NX	30	AA	1.19	3 1/32	1⅞	5 1/16	Binding Post	47	—, +22½ +45	17, 18	1	30
M30	30	F90	2.0	3 9/16	1¾	5½	Socket	46	—, +45	28, 29	1	30
5308	30	B	2.6	4 1/16	2 19/32	5⅝	Binding Post	48	—, +22½ +45	26, 27	1	30
D30	30	F100	4.5	5⅛	2 1/16	7¼	Socket	50	—, +22½ +45	48, 49	1	30
2308SC	30	D	7.6	8 3/32	2 31/32	7 9/16	Spring Clip	49	—, +22½ +45	37, 38	1	30
10308SC	30	F	11.25	8 3/32	4 3/32	7 9/16	Spring Clip	51	—, +22½ +45	50, 51	1	30
21308SC	30	G	12.5	8 3/16	4 17/32	7 13/16	Spring Clip	52	—, +22½ +45	54, 55	1	30

BURGESS 67½ to 90 Volt Types

No. K45

No. P45

No. XX45

No. UX45

No. XX50

No. P60

No. V60

No. N60X

Battery No. (In order of Increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAX. DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. by	Battery Voltage Equals Volts Per Cell Times
UX45	45	F20	0.22	1 7/32	31/32	3½	Small Snap	15A	—, +67½	3, 4	1	45
K45	45	F30	0.44	2 11/16	1 5/16	2 5/16	Large Snap	53	—, +67½	5, 6	1	45
P45	45	P	0.55	1 59/64	1 1/64	5⅜	Large Snap	54	—, +67½	7, 8	1	45
XX45	45	F40	0.72	2¾	1 11/32	3 45/64	Large Snap	55	—, +67½	11, 12	1	45
XX50	50	F40	0.80	1⅞	1 5/16	6 7/16	Large Snap	56	—, +75	11, 12	1	50
P60	60	P	0.75	1 15/16	1 1/32	7 7/16	Large Snap	57	—, +90	7, 8	1	60
V60	60	F40	1.27	3 23/32	1 9/32	3 11/16	Large Snap	58	—, +90	11, 12	1	60
N60X	60	F40	1.06	1 29/32	1 11/32	7⅛	Large Snap	59	—, +90	11, 12	1	60

BURGESS 225 to 510 Volt Types

No. XX150

No. N150

No. U160

No. U200

No. U320

PHYSICAL DESCRIPTION

Battery No. (In order of increasing Physical Size)	CELLS USED		Battery Weight in Pounds	MAXIMUM DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. By	Batt. Voltage Equals Volts Per Cell Times
XX150	150	F40	2.25	4¼	2⅝	4¼	Pin Jacks	60	—, +225	11, 12	1	150
N150	150	F40	2.31	3⅝	2 13/16	4 25/32	Socket	61	—, +180 +225	11, 12	1	150
U160	160	F20	0.750	2 9/16	1 5/16	4 7/16	Socket	62	—, +240	3, 4	1	160
U200	200	F20	1.00	2 11/16	2 7/32	3 13/16	Pin Jacks	63	—, +300	3, 4	1	200
U320	320	F20	1.65	3	1 19/32	5½	Flat Contacts	64	—, +180 +510	3, 4	1	320

BURGESS Combined Voltage Types
A & B Packs

No. 17GD60

No. T5Z50

No. T6Z60

No. F6A60

No. G6B60

PHYSICAL DESCRIPTION

Battery No.	CELLS USED		Battery Weight in Pounds	MAXIMUM DIMENSIONS INCHES			TERMINALS		Voltage Taps	SERVICE LIFE		
	Number	Size		Length	Width	Overall Height	Type	Sketch No.		Graph No.	Divide Drain of using Equip. By	Batt. Voltage Equals Volts Per Cell Times
17GD60	15 60	G D	16.0	15 9/16	4¼	6¾	Socket	65	−A, +1½A −B, +90B	54, 55 48, 49	15 1	1 60
T5Z50	5 49	CD F70	3.62	8½	3 11/16	2 9/32	Socket	66	−A, +6A, +7½A −B, +75B	35, 36 20, 21	1 1	5 49
T6Z60	6 60	CD F70	4.25	8 15/16	2 3/16	3 13/16	Socket	67	−A, +7½A, +9A −B +90B	35, 36 20, 21	1 1	6 60
F6A60	6 60	F F70	5.0	9 3/32	2 23/32	4 3/16	Socket	67	−A, +7½A, +9A −B, +90B	50, 51 20, 21	1 1	6 60
G6B60	6 60	F F90	6.3	14	2 11/16	3 31/32	Recessed Plug	69	−A, +9A −B, +90B	50, 51 28, 29	1 1	6 60

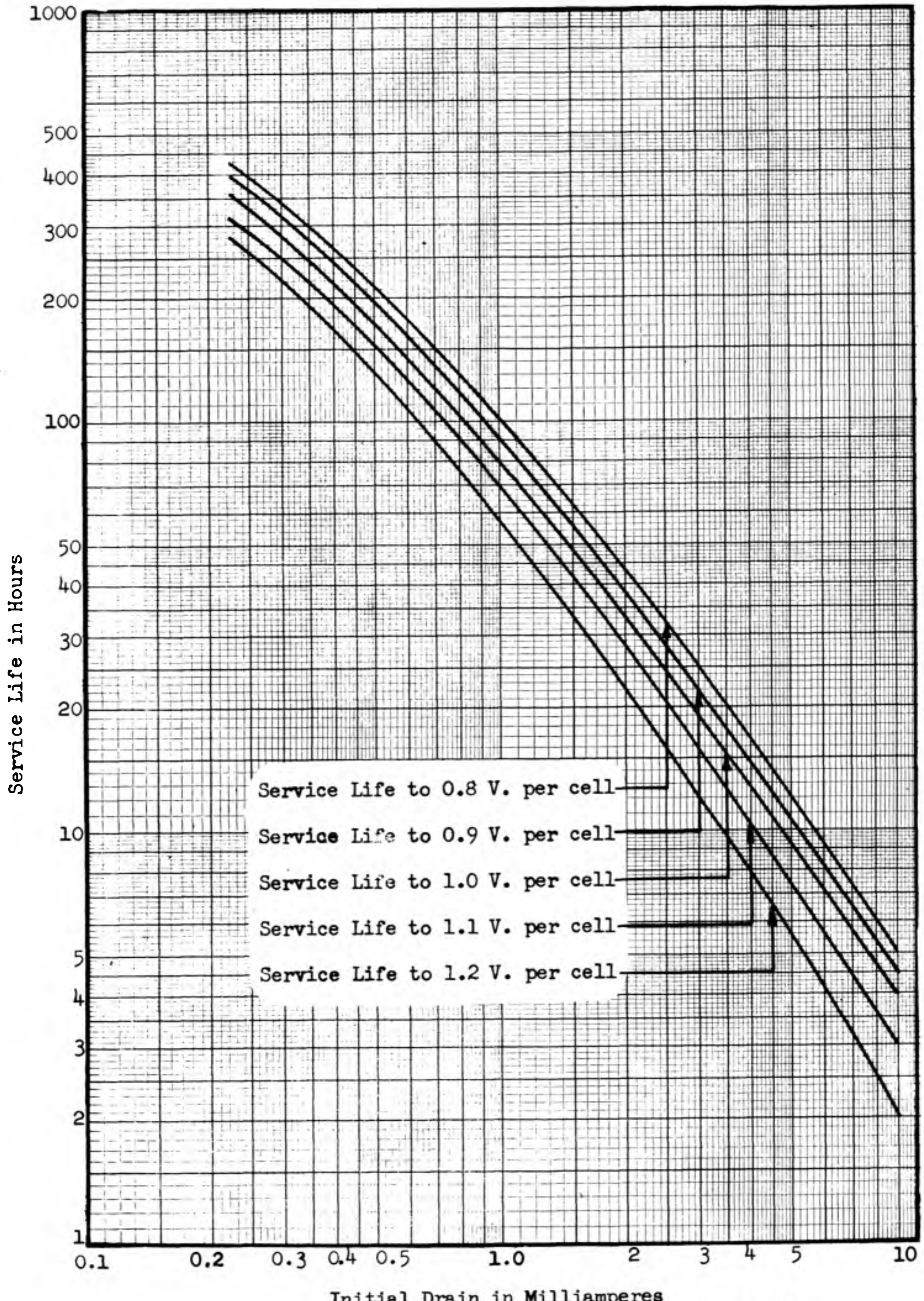
GRAPH NO.

1

BURGESS

'Y' CELLS
(ASA Cell Size F15)

Service Life When Discharged Continuously At 70° F.



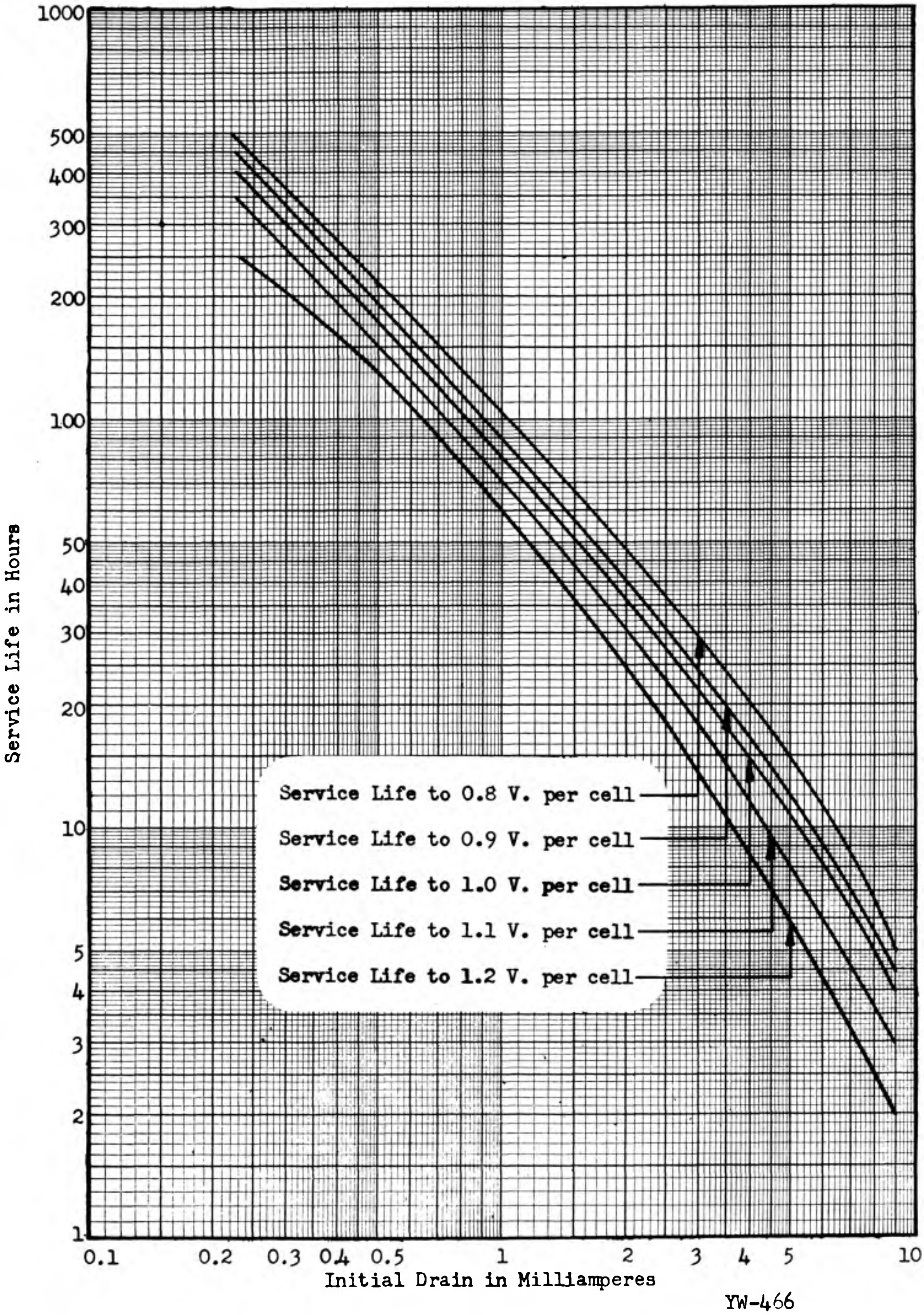
Y-466

BURGESS

GRAPH NO. 2

'Y' CELLS
(ASA Cell Size F15)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



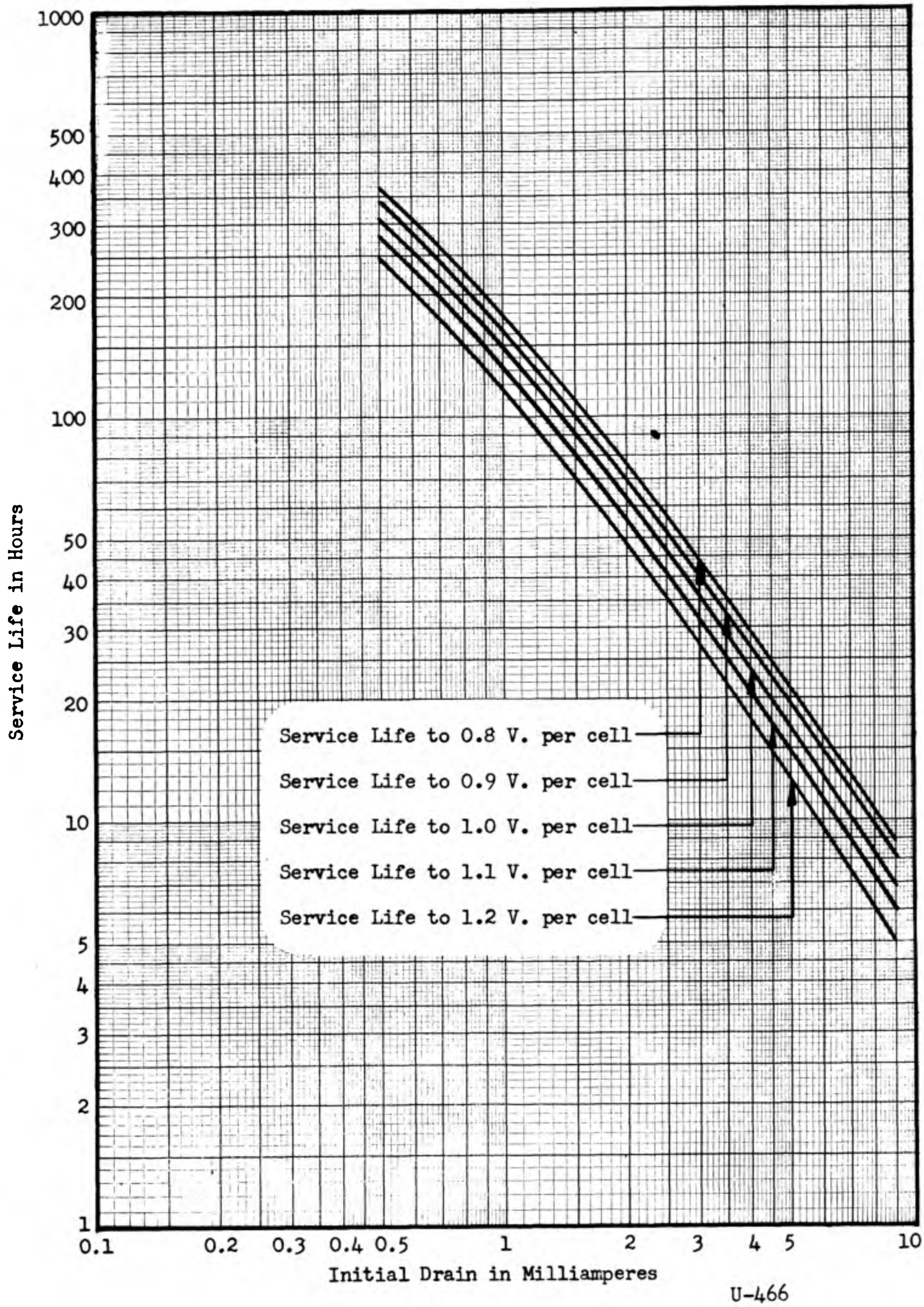
GRAPH NO.

3

BURGESS

'U' CELLS
(ASA Cell Size F20)

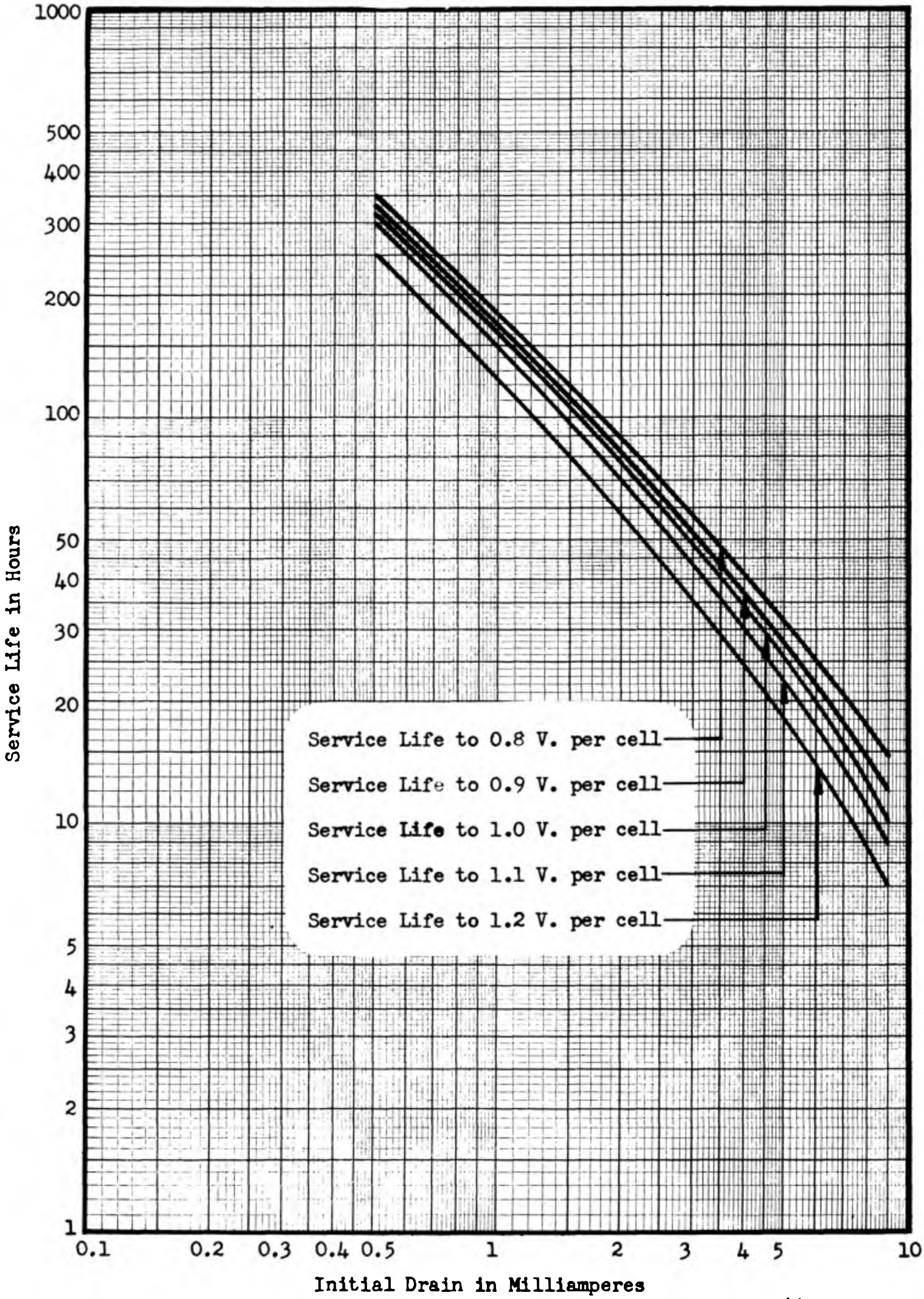
Service Life When Discharged Continuously At 70° F.



BURGESS

'U' CELLS
(ASA Cell Size F20)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



U-466

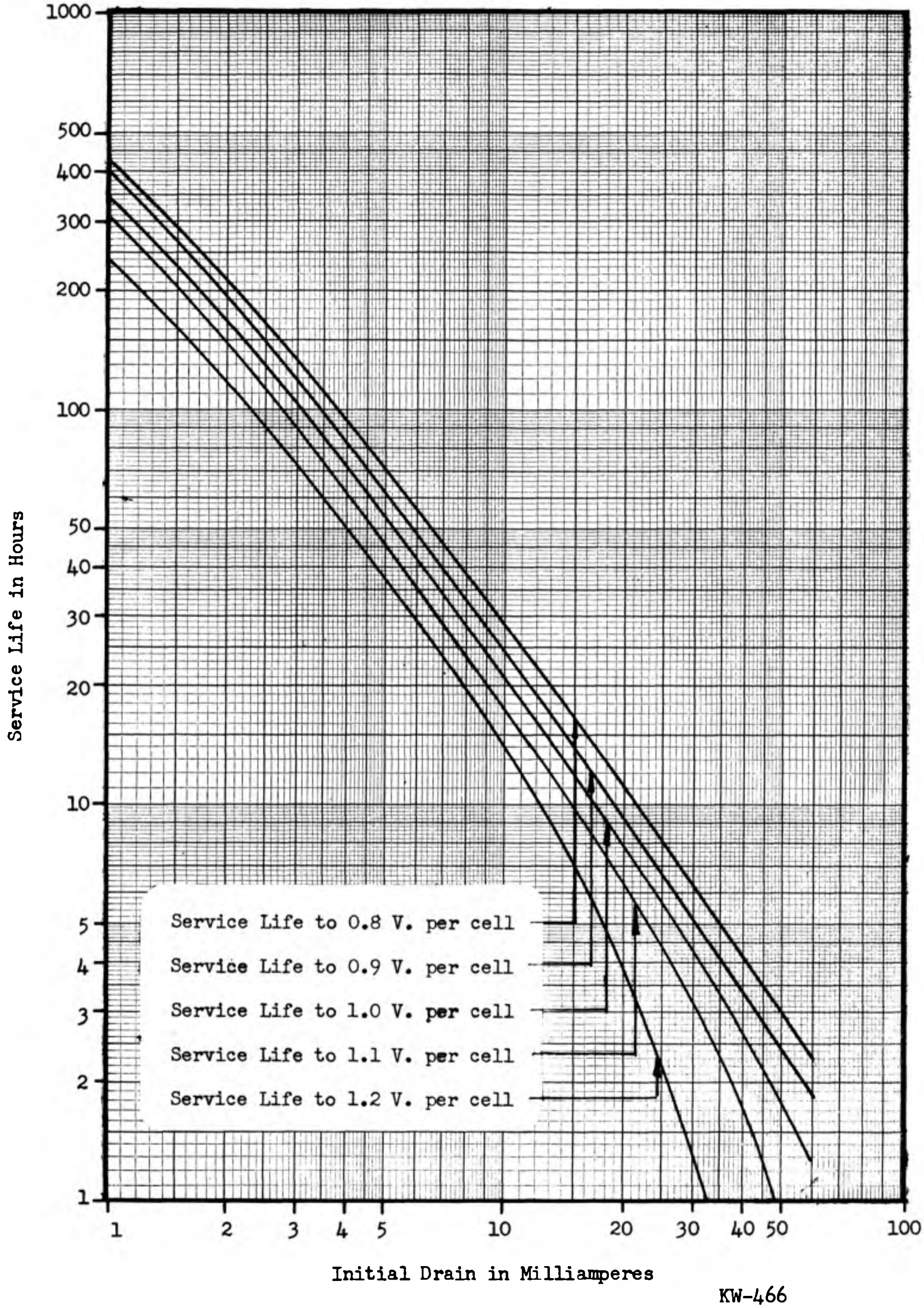
GRAPH NO.

5

BURGESS

'K' CELLS
(ASA Cell Size F30)

Service Life When Discharged Continuously At 70° F.



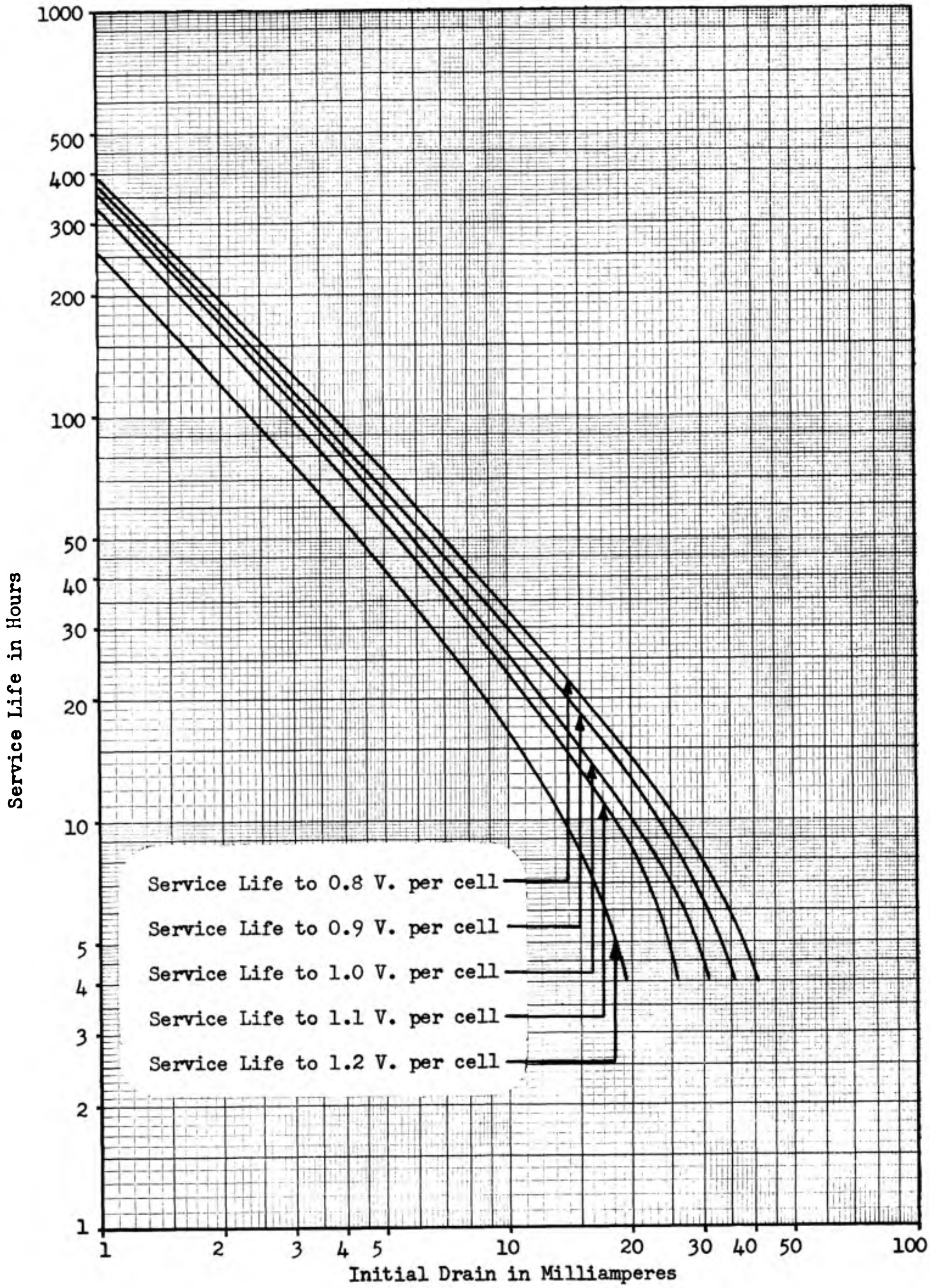
KW-466

BURGESS

GRAPH NO. 6

'K' CELLS
(ASA Cell Size F30)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



KW-466

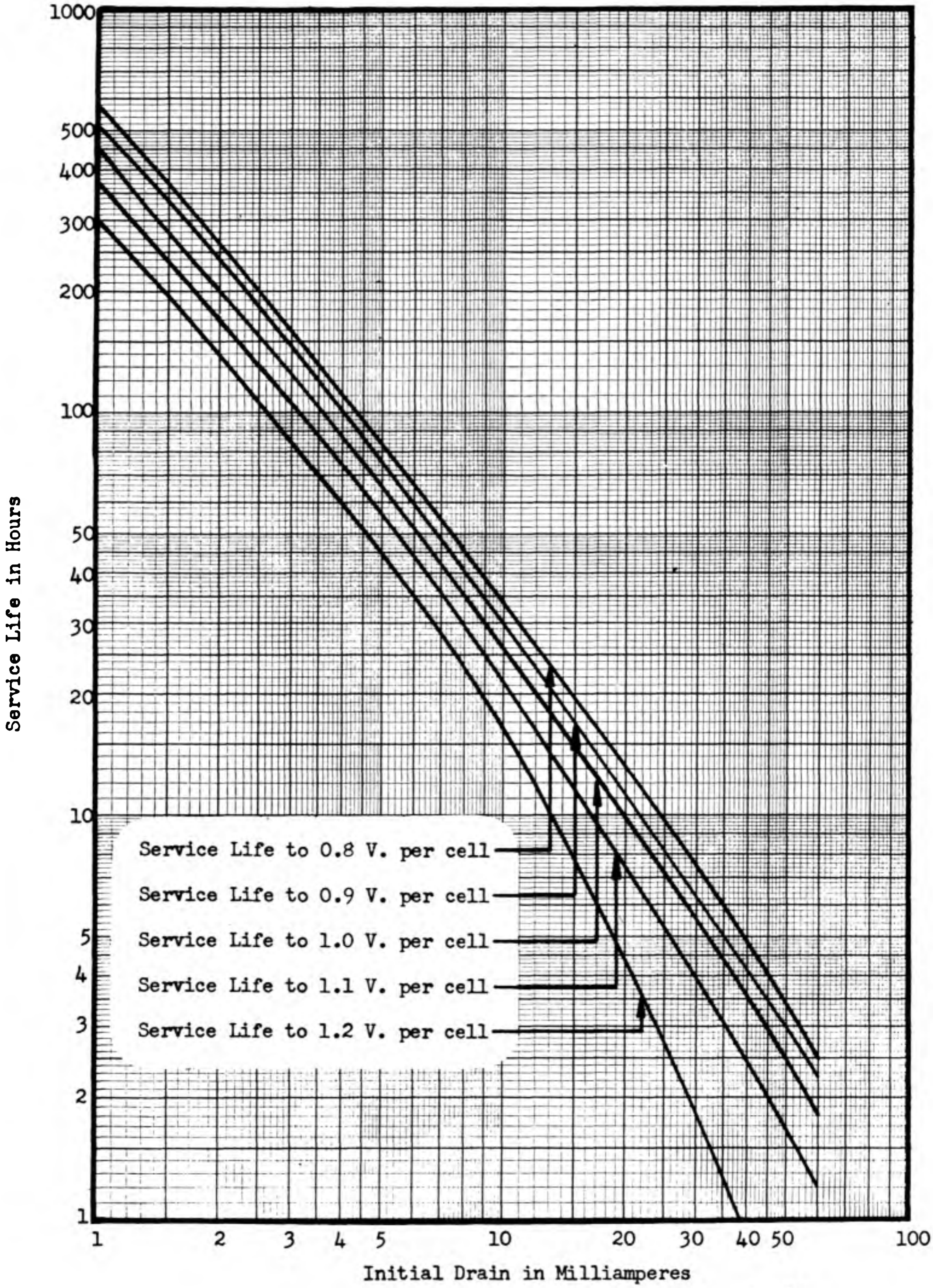
GRAPH NO.

7

BURGESS

'P' CELLS

Service Life When Discharged Continuously At 70° F.



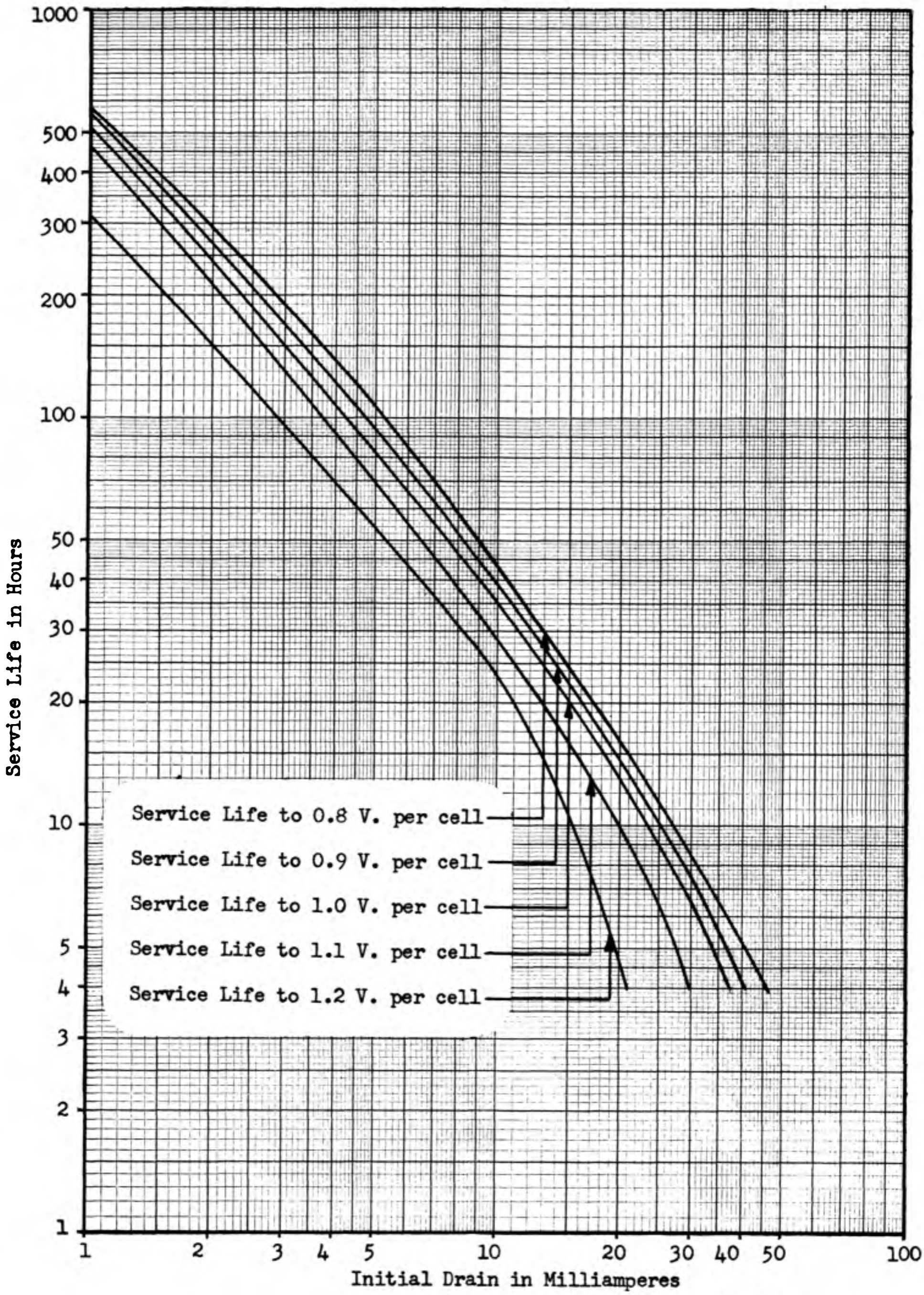
P-466

BURGESS

GRAPH NO. 8

'P' CELLS

Service Life When Discharged 4 Hrs. Per Day At 70° F.



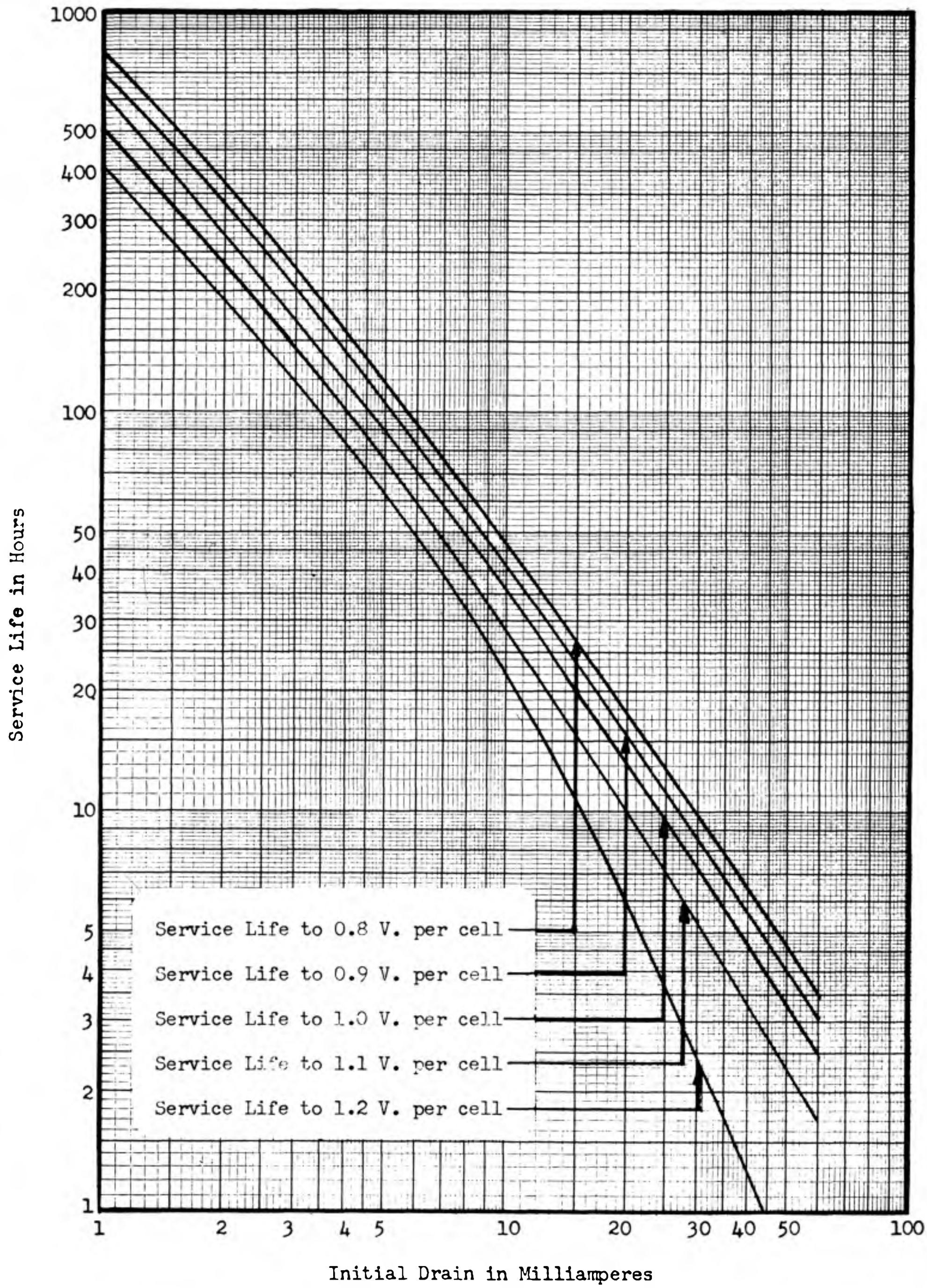
P-466

GRAPH NO.
9

BURGESS

'PT' CELLS

Service Life When Discharged Continuously At 70° F.

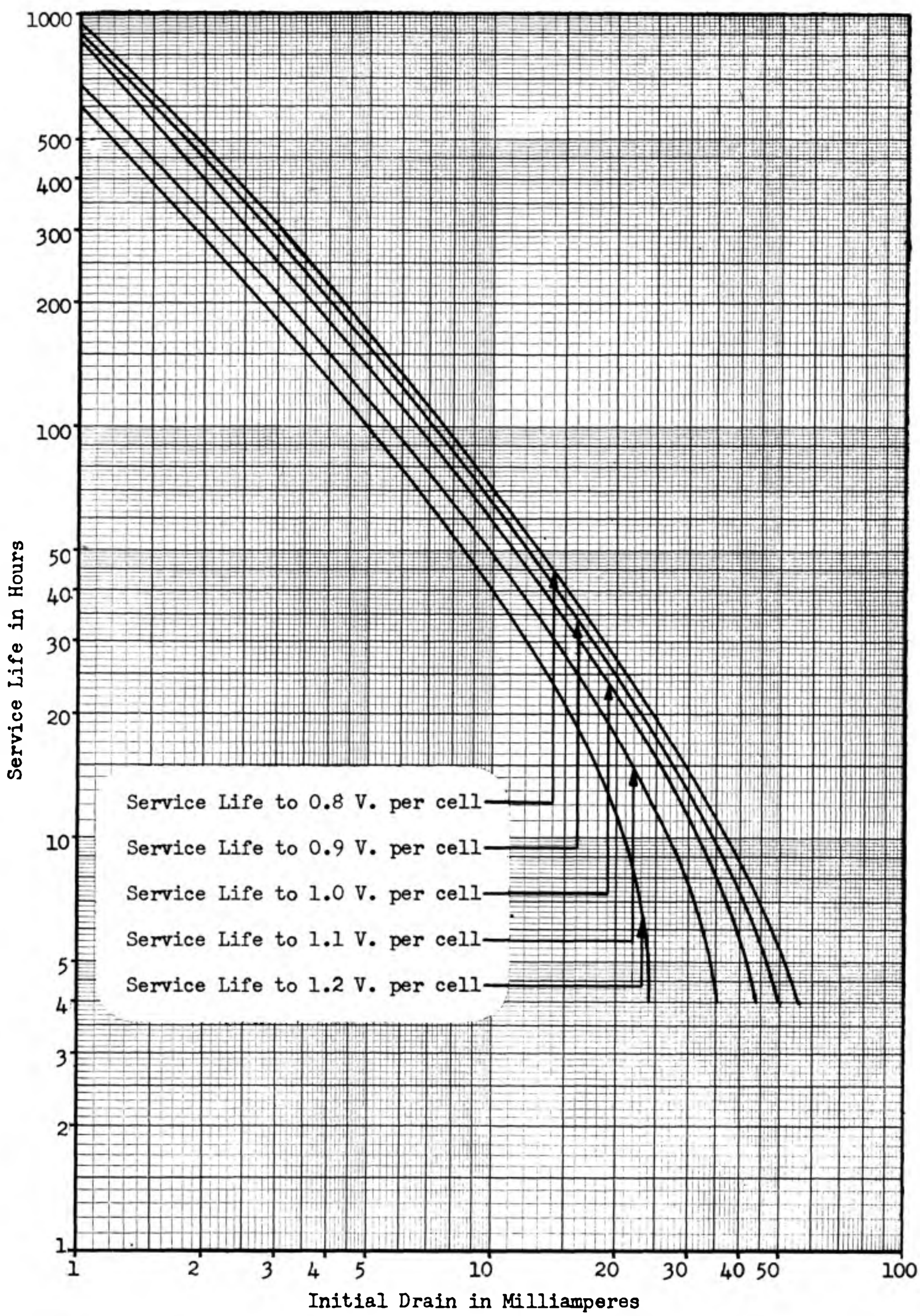


PT-525

BURGESS

'PT' CELLS

Service Life When Discharged 4 Hrs. Per Day At 70° F.



PT-543

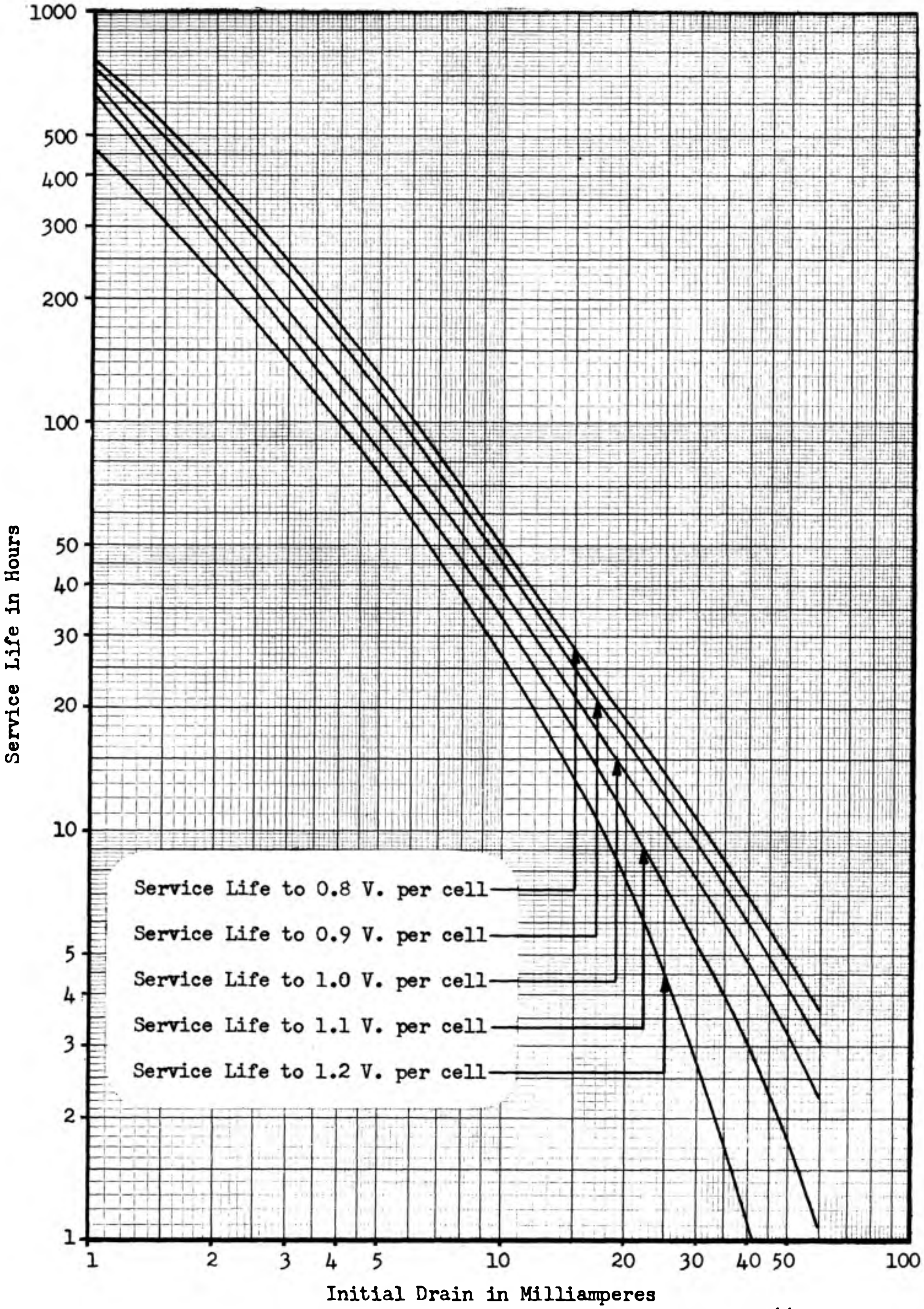
GRAPH NO.

11

BURGESS

'N' CELLS
(ASA Cell Size F40)

Service Life When Discharged Continuously At 70° F.



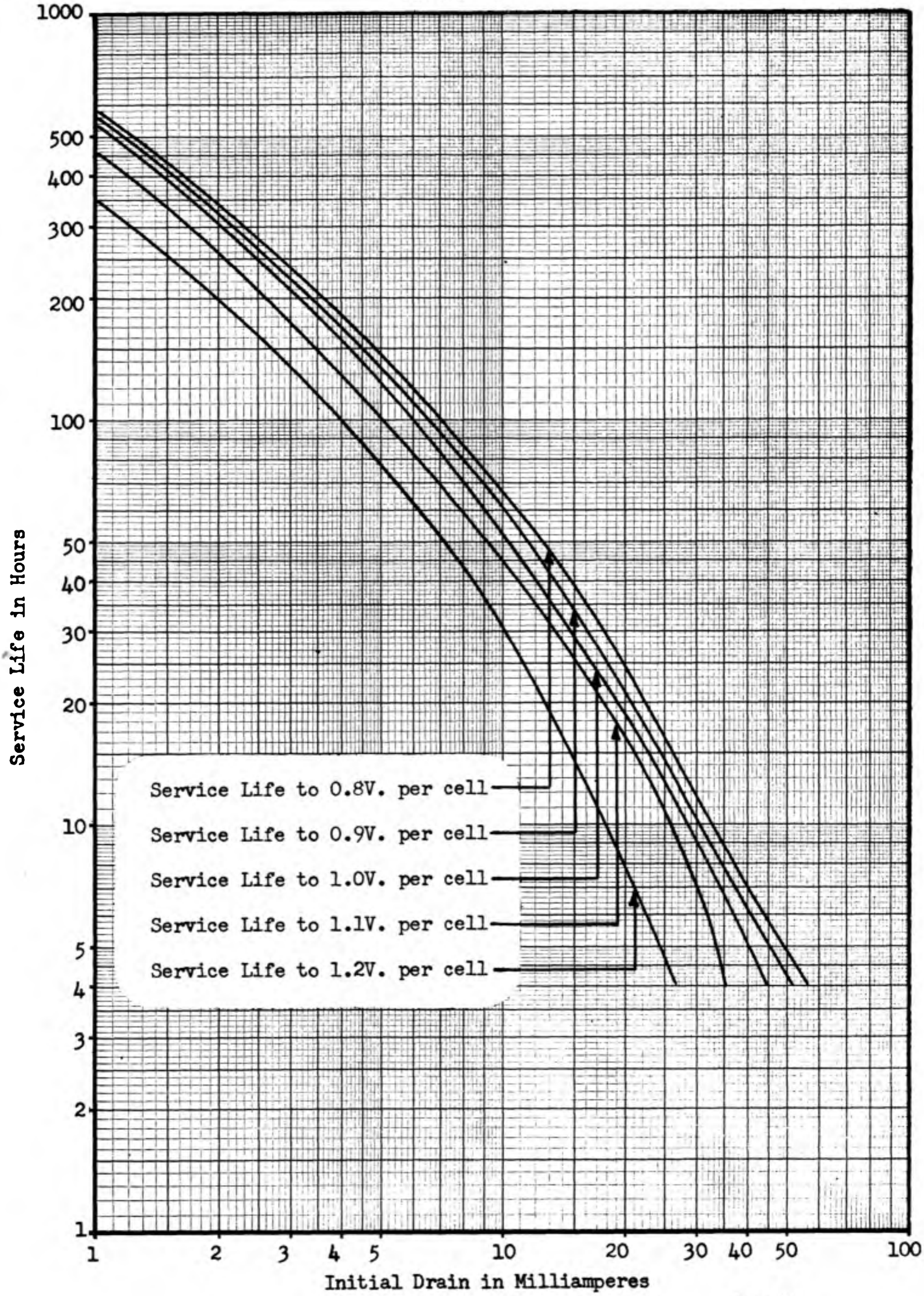
NW-466

BURGESS

GRAPH NO. 12

'N' SIZE CELLS
(ASA Cell Size F40)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



NW-466

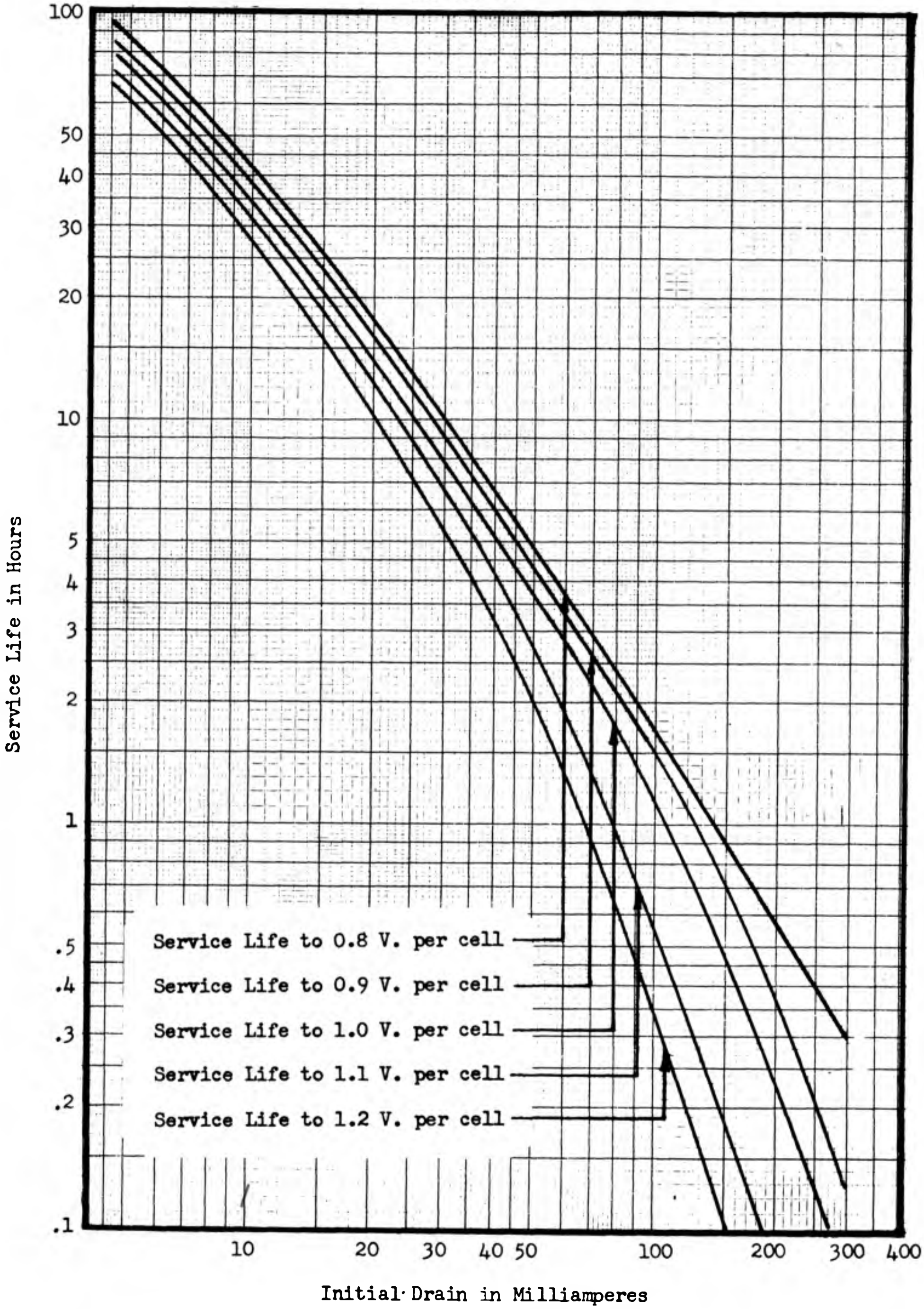
GRAPH NO.

13

BURGESS

'N' SIZE CELLS
(ASA Cell Size N)

Service Life When Discharged Continuously At 70° F.



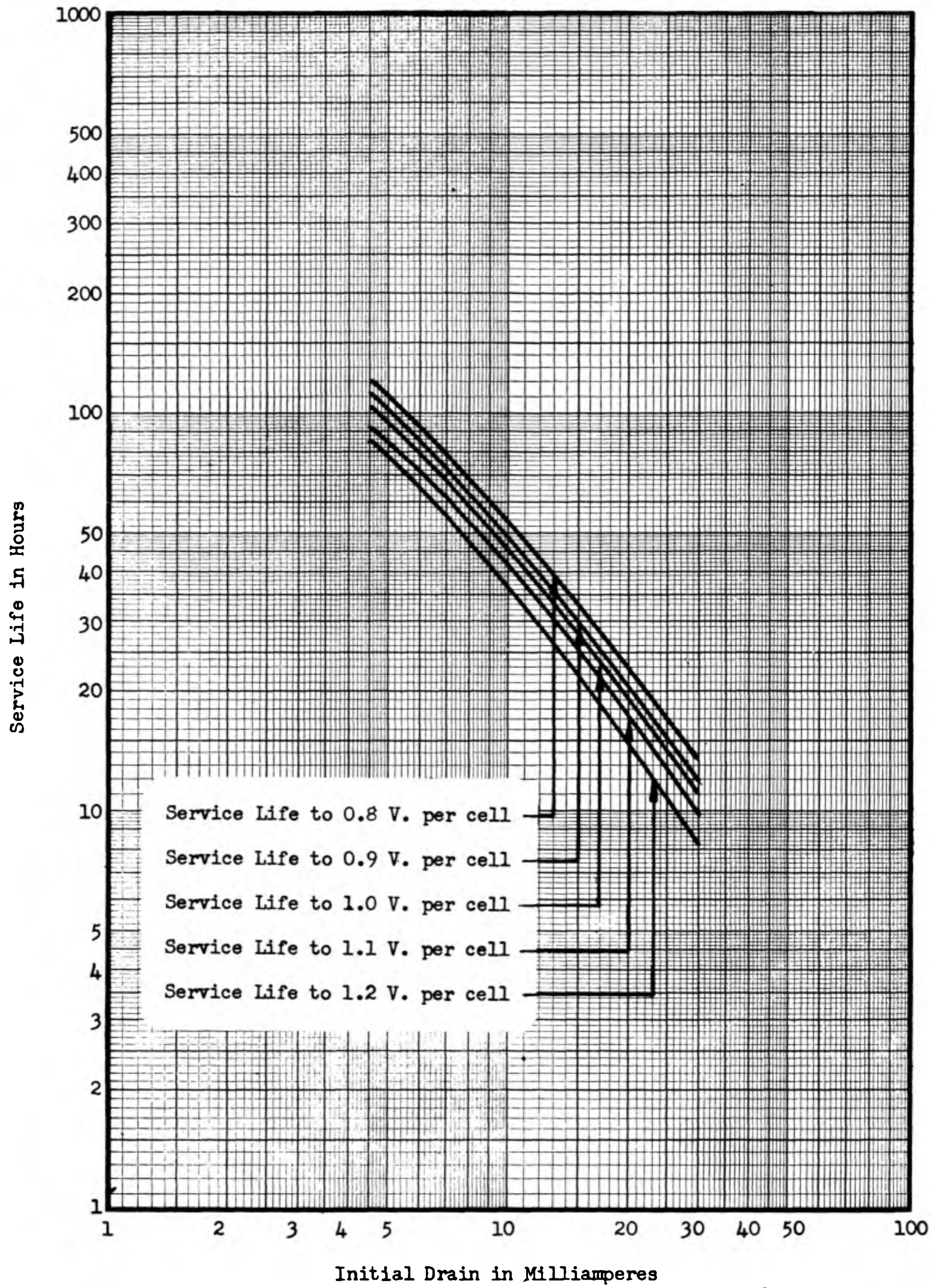
N-525

BURGESS

'N' SIZE CELLS (ASA Cell Size N)

GRAPH NO. 14

Service Life When Discharged 4 Hrs. Per Day At 70° F.



N-525

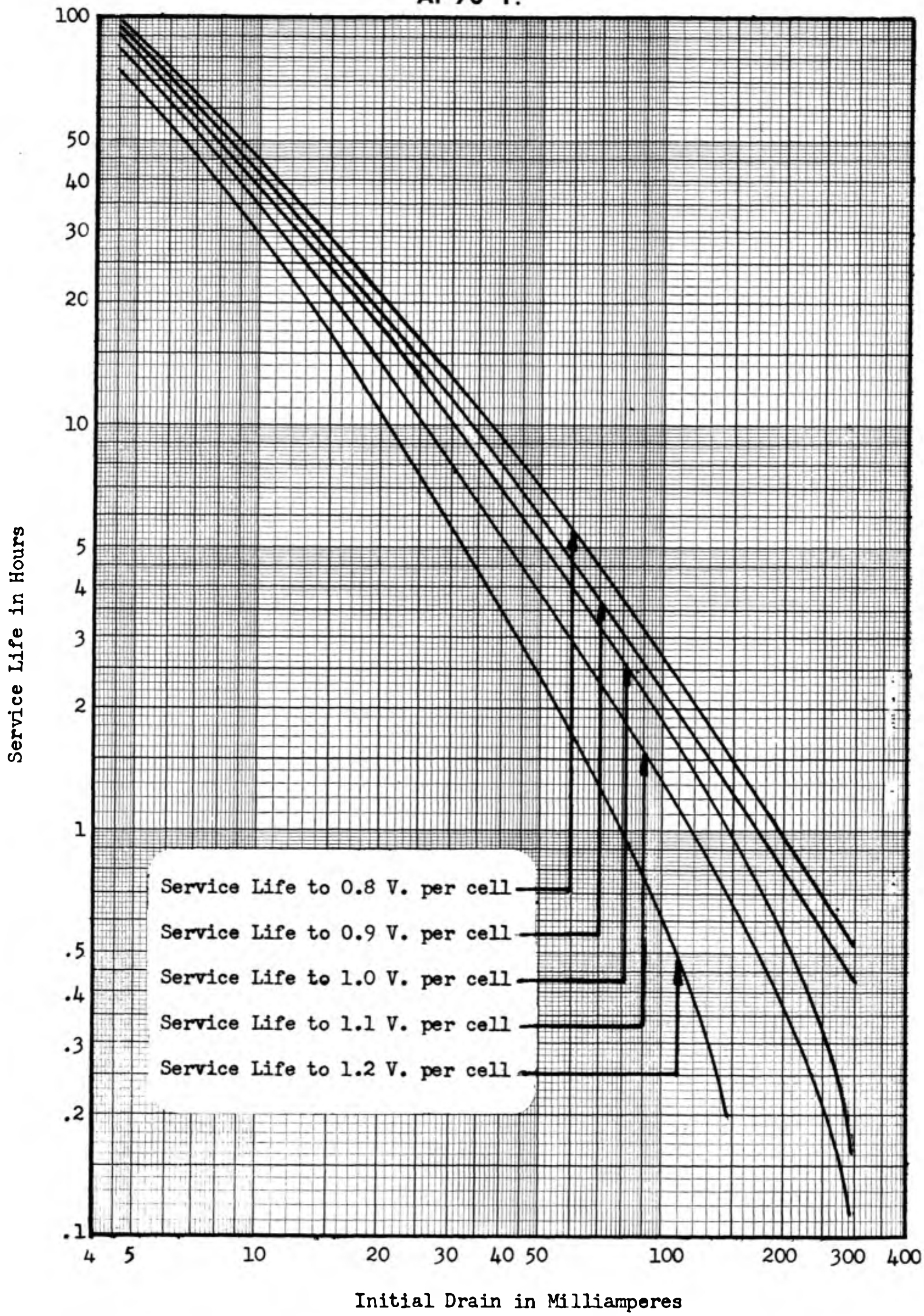
GRAPH NO.

15

BURGESS

NUMBER 7 SIZE CELLS
(ASA Cell Size AAA)

Service Life When Discharged Continuously At 70° F.



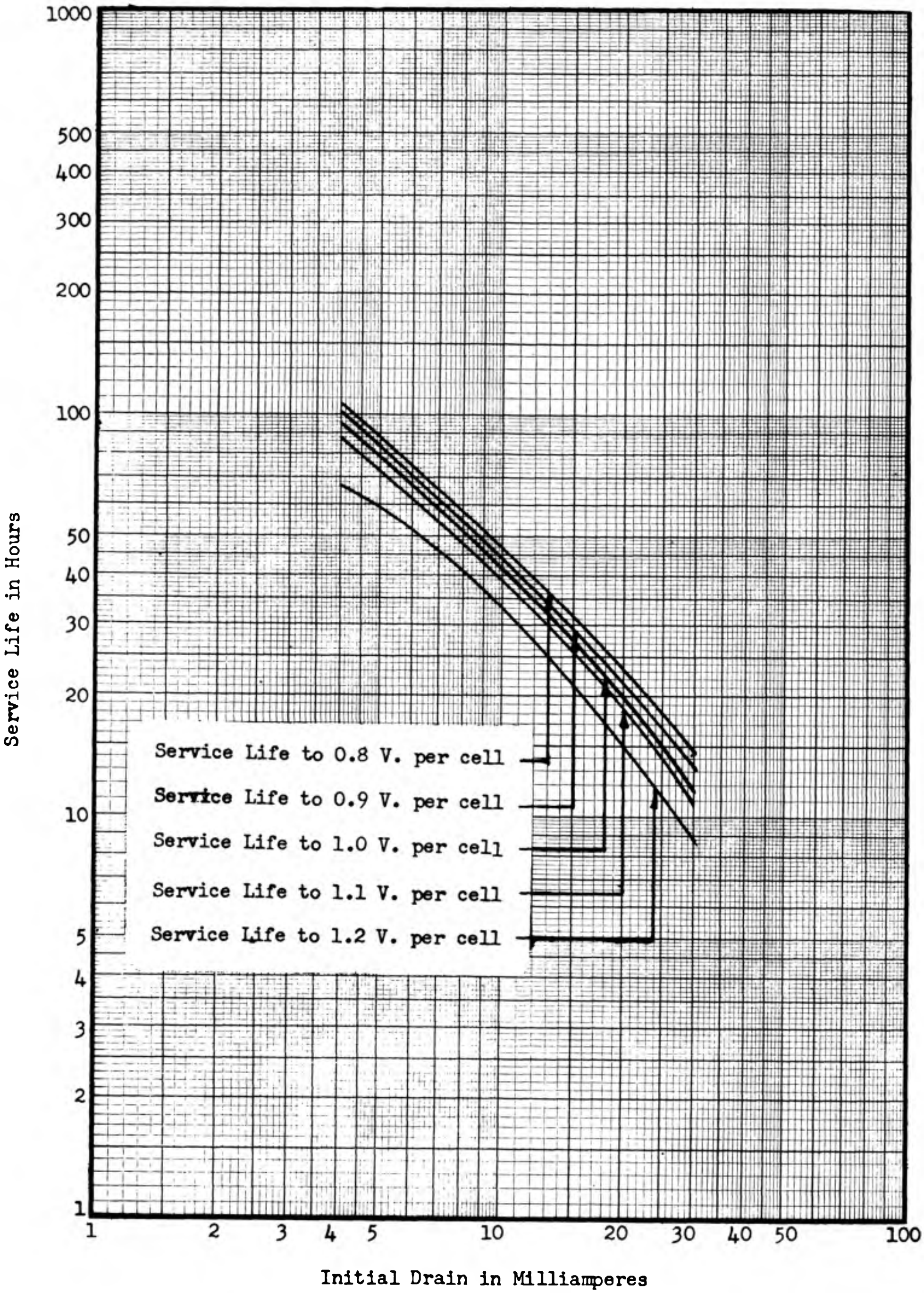
AAA-525

BURGESS

GRAPH NO. 16

NUMBER 7 SIZE CELLS (ASA Cell Size AAA)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



AAA-525

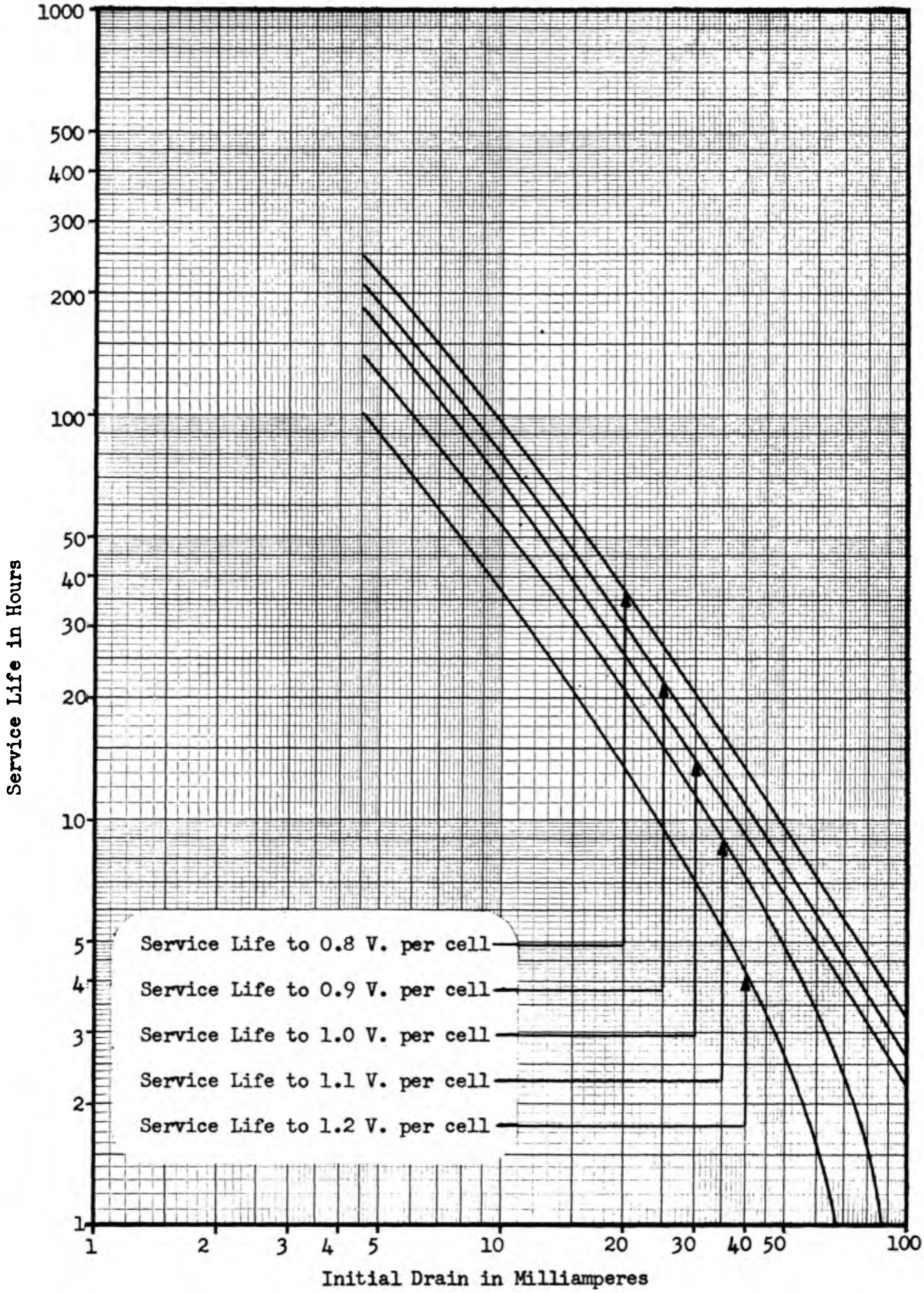
GRAPH NO.

17

BURGESS

NUMBER 9 CELLS
(ASA Cell Size AA)

Service Life When Discharged Continuously At 70° F.



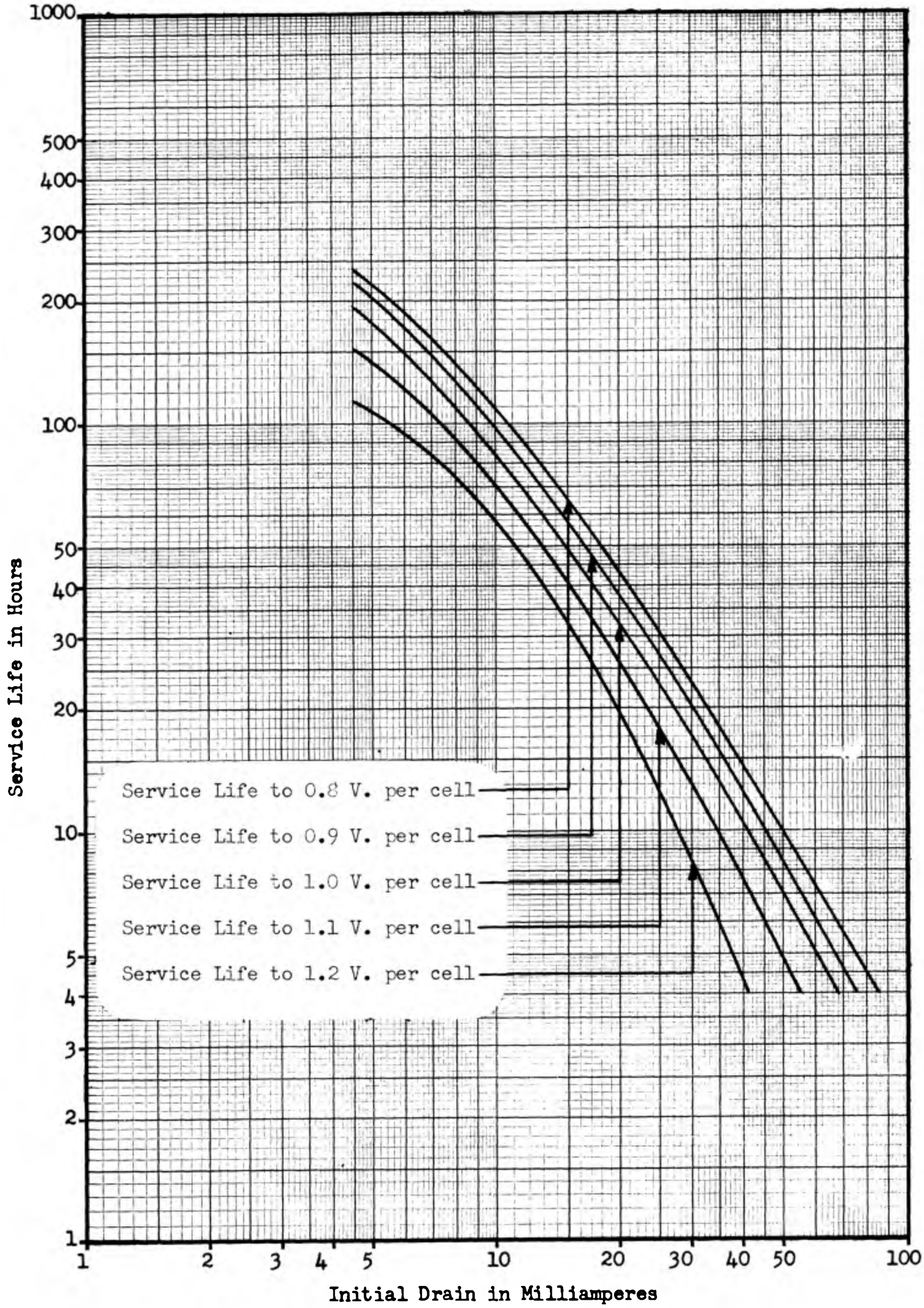
9MS-464

BURGESS

GRAPH NO. 18

NUMBER 9 CELLS (ASA Cell Size AA)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



9MS-464

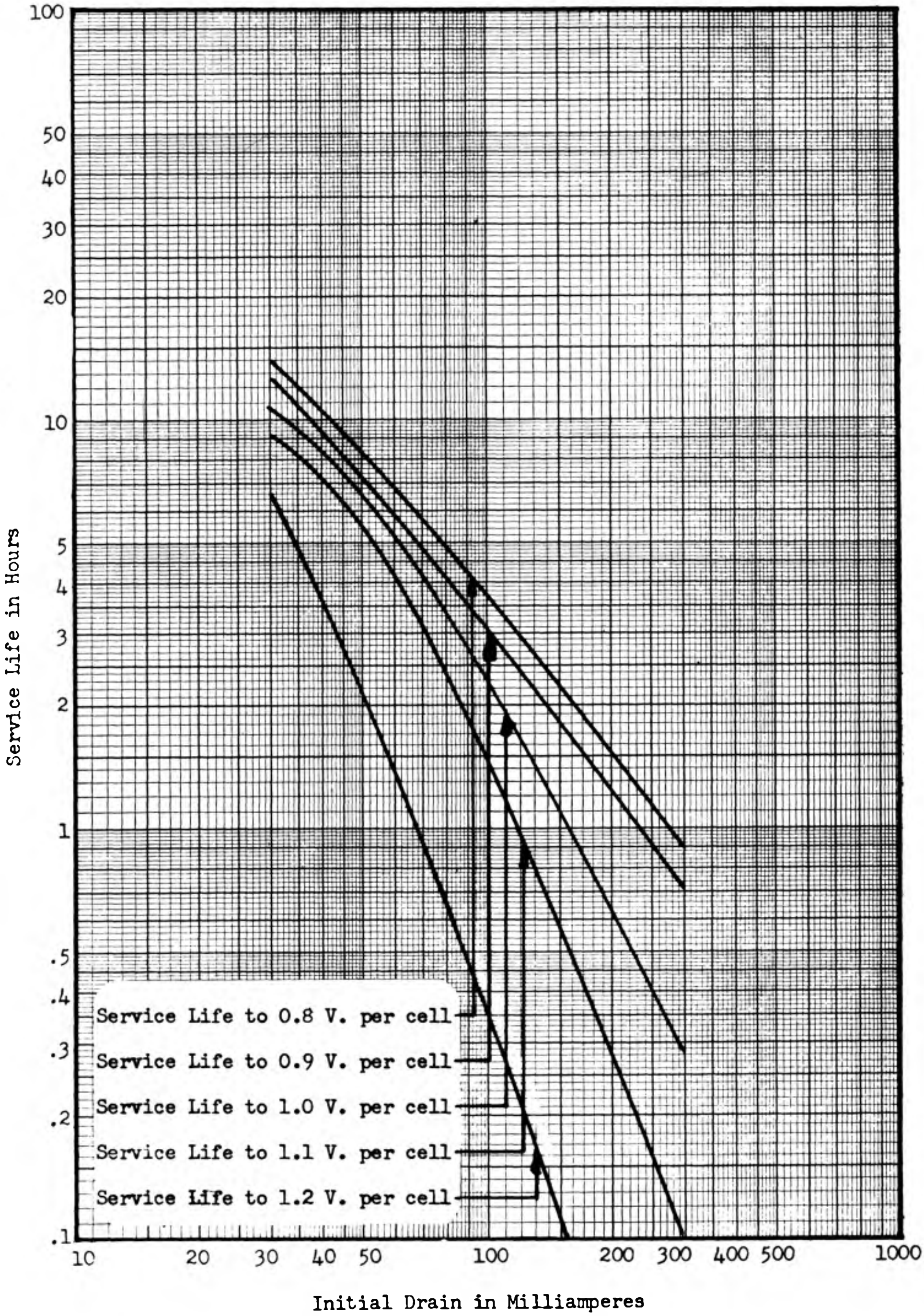
GRAPH NO.

19

BURGESS

NUMBER 920 CELLS
(ASA Cell Size AA)

Service Life When Discharged Continuously At 70° F.



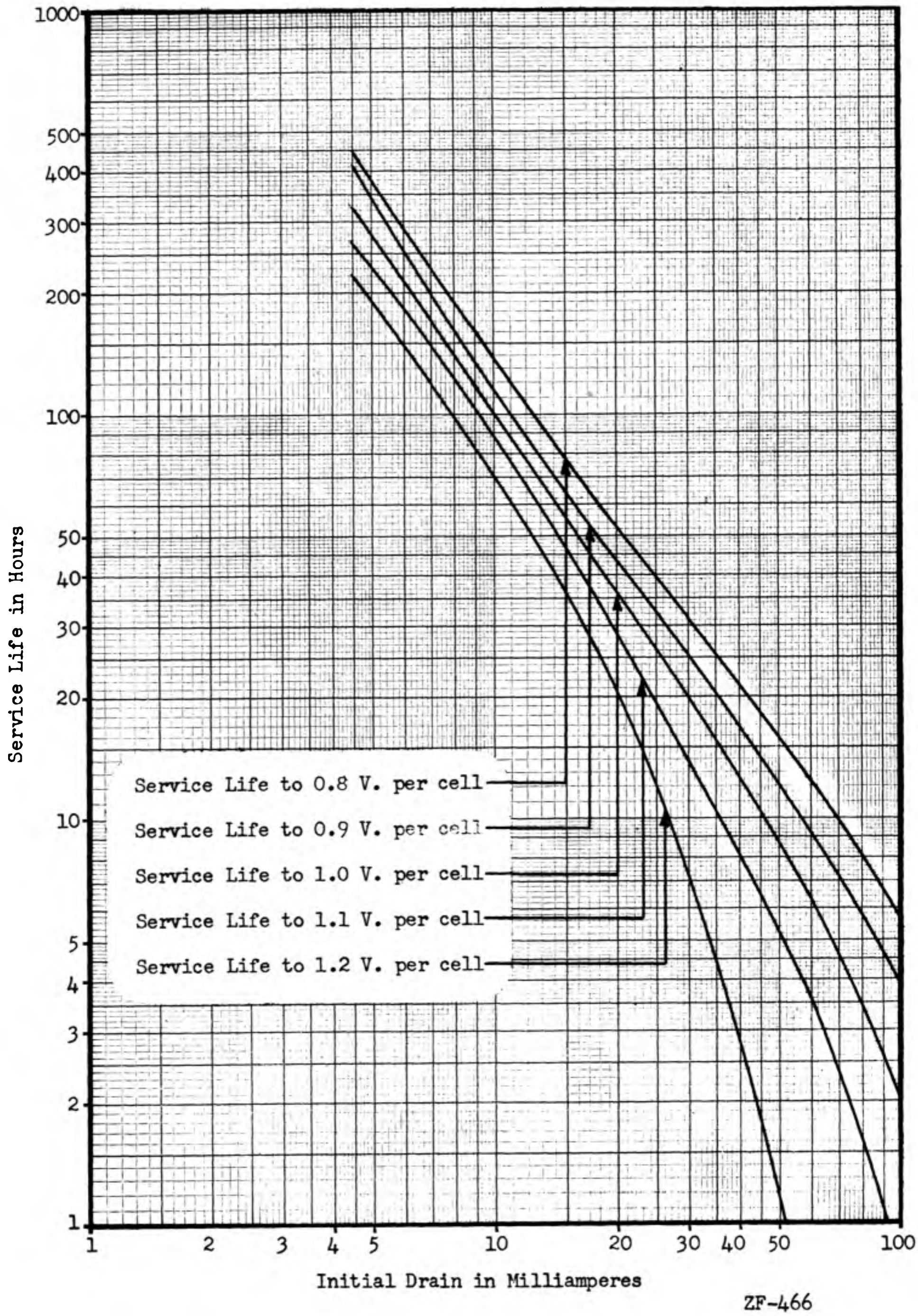
AA-525

BURGESS

GRAPH NO. 20

'Z' CELLS
(ASA Cell Size F70)

Service Life When Discharged Continuously At 70° F.



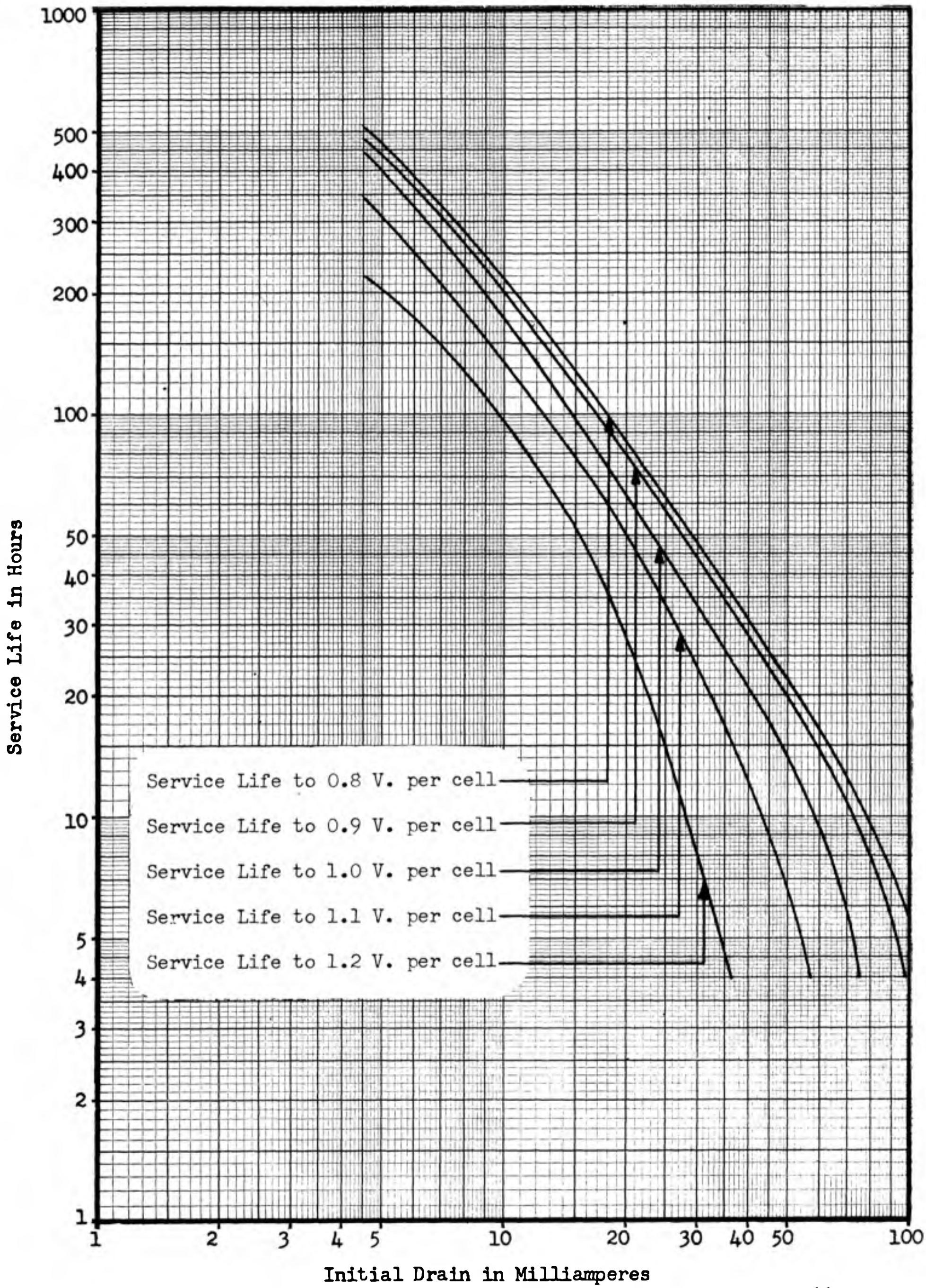
GRAPH NO.

21

BURGESS

'Z' CELLS
(ASA Cell Size F70)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



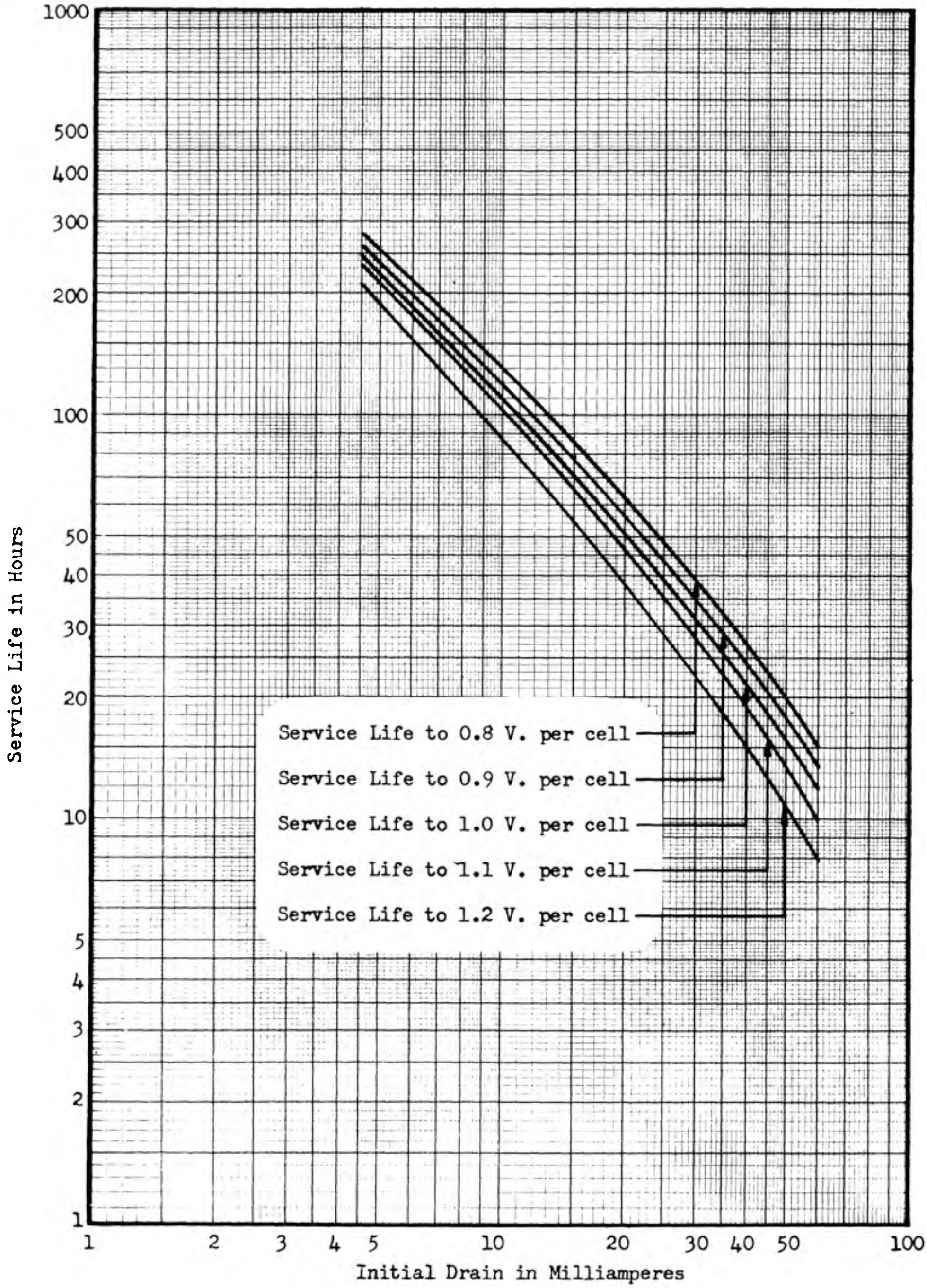
ZF-466

BURGESS

GRAPH NO. 22

NUMBER 9I CELLS
(ASA Cell Size AA)

Service Life When Discharged Continuously At 70° F.



9I-464

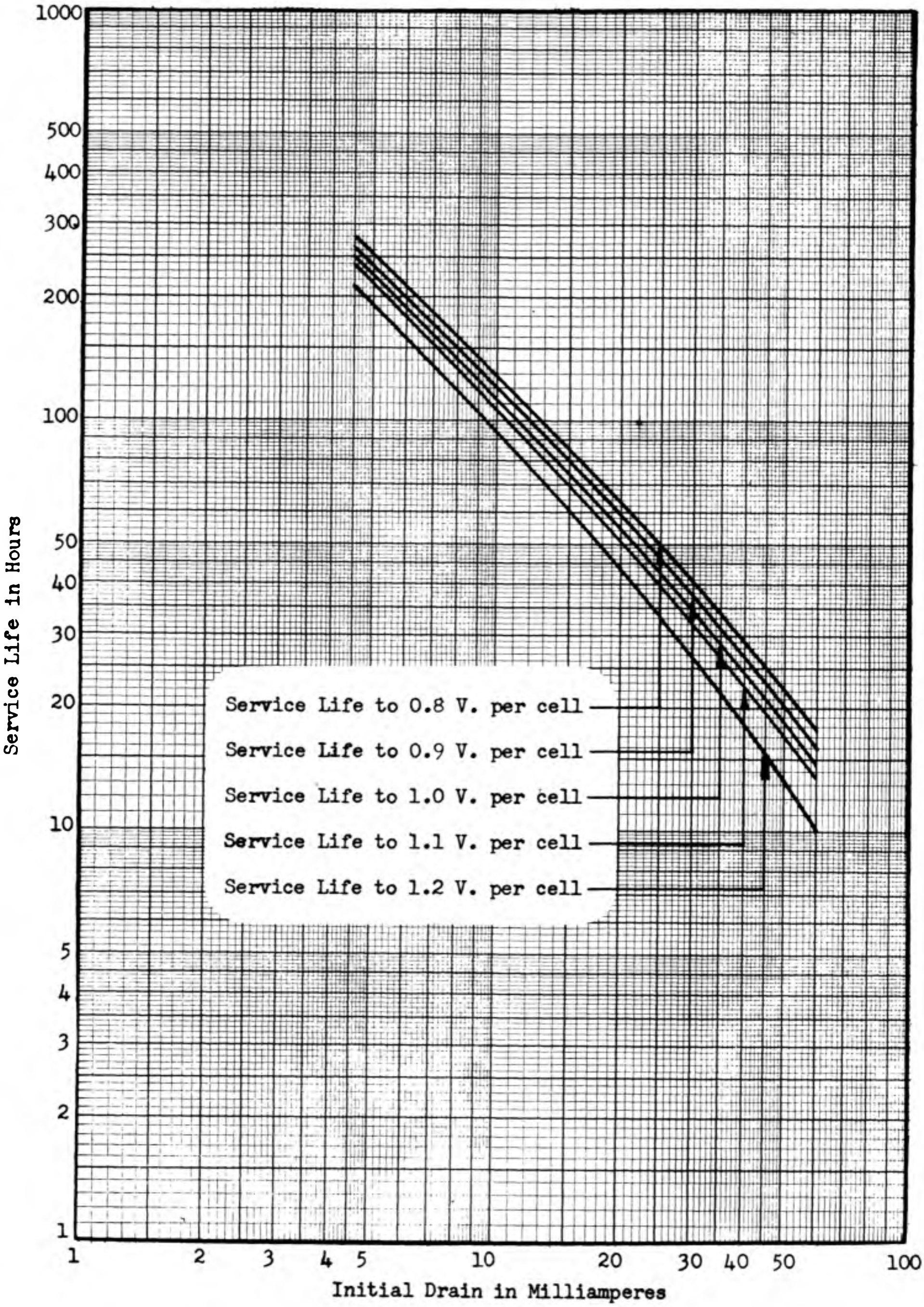
GRAPH NO.

23

BURGESS

NUMBER 9I CELLS
(ASA Cell Size AA)

Service Life When
Discharged 4 Hrs. Per Day
At 70° F.



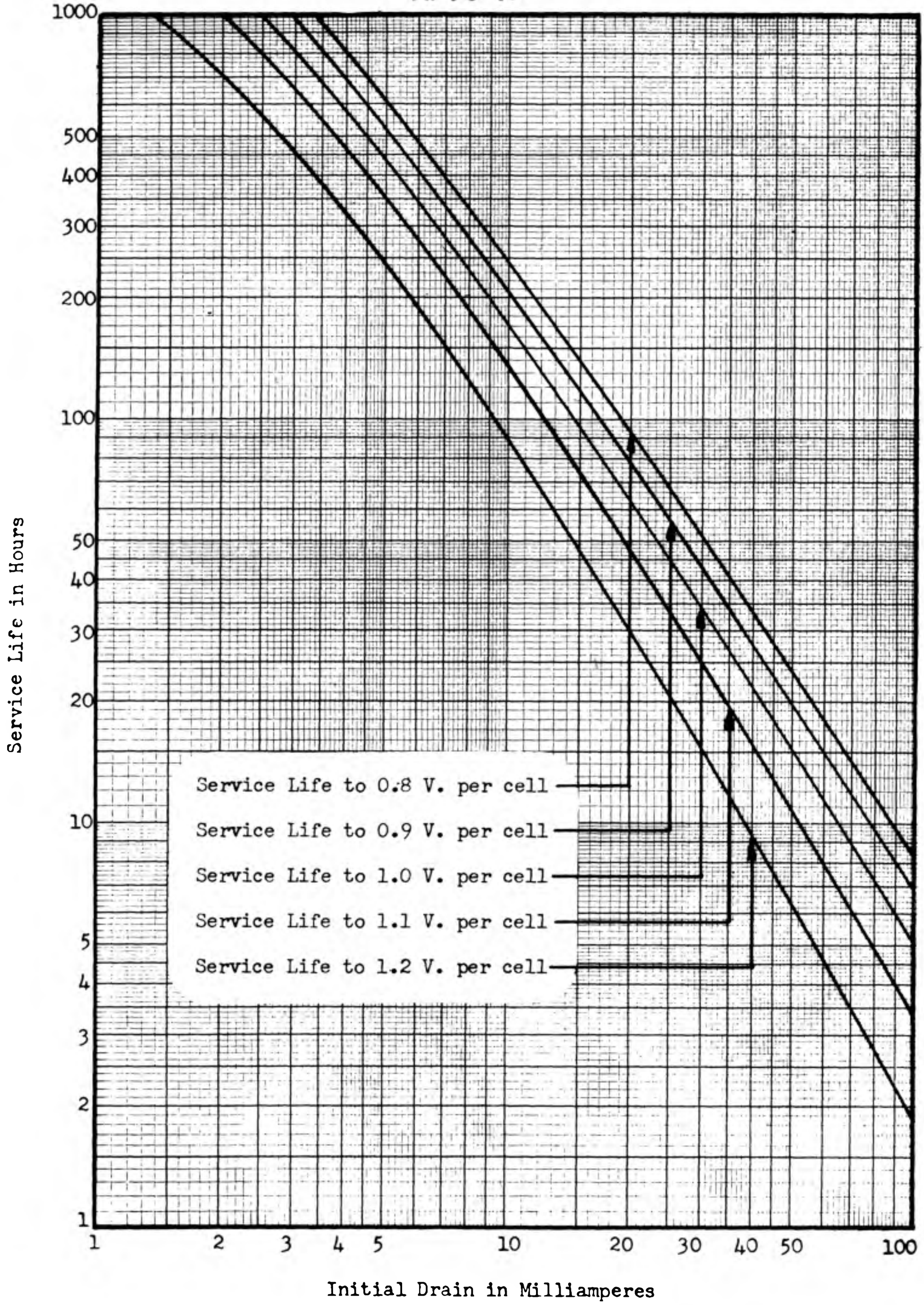
9I-464

BURGESS

NUMBER 4 CELLS
(ASA Cell Size A)

GRAPH NO. 24

Service Life When Discharged Continuously At 70° F.



A-525

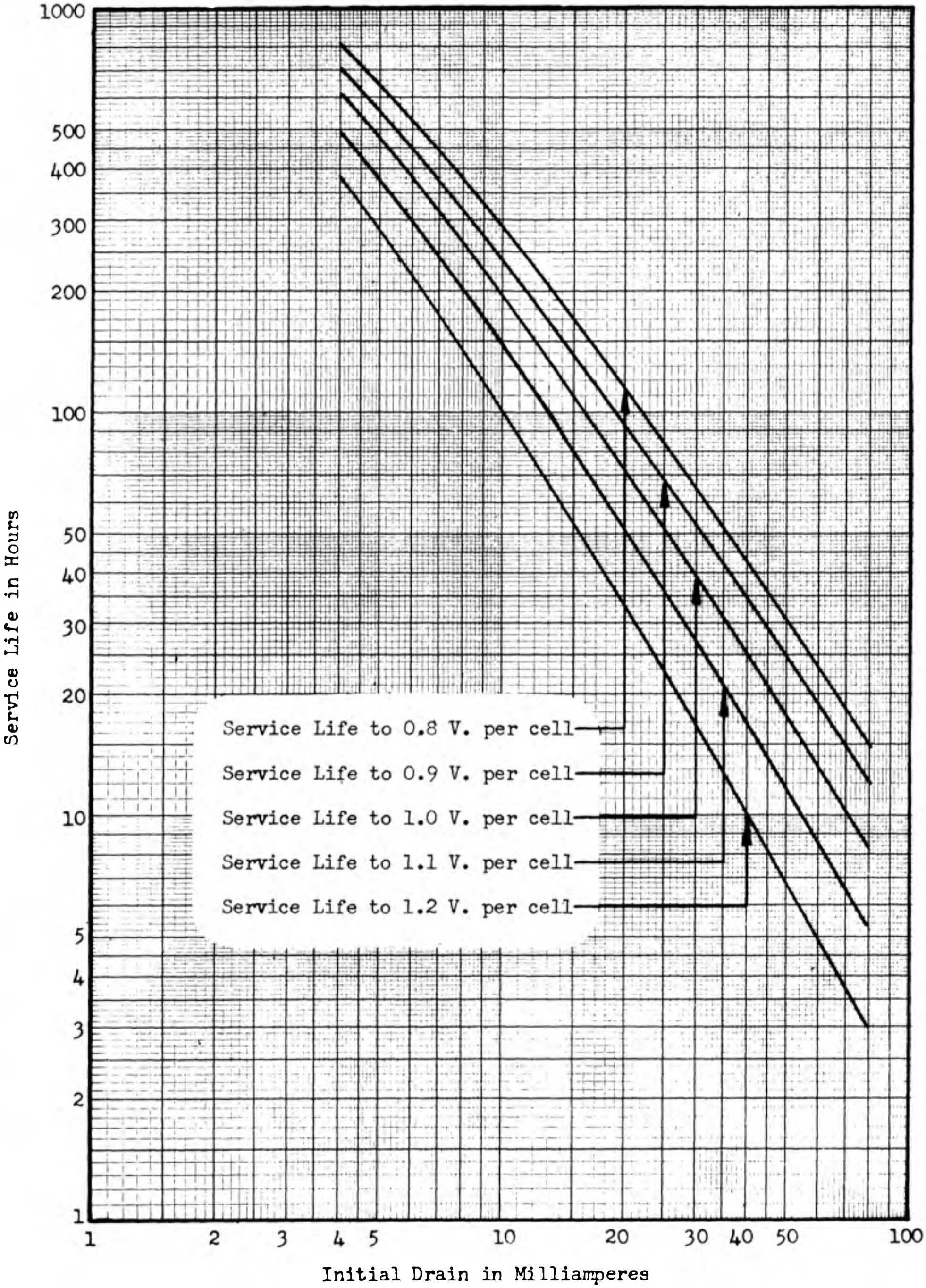
GRAPH NO.

25

BURGESS

NUMBER 4 CELLS
(ASA Cell Size A)

Service Life When
Discharged 4 Hrs. Per Day
At 70° F.

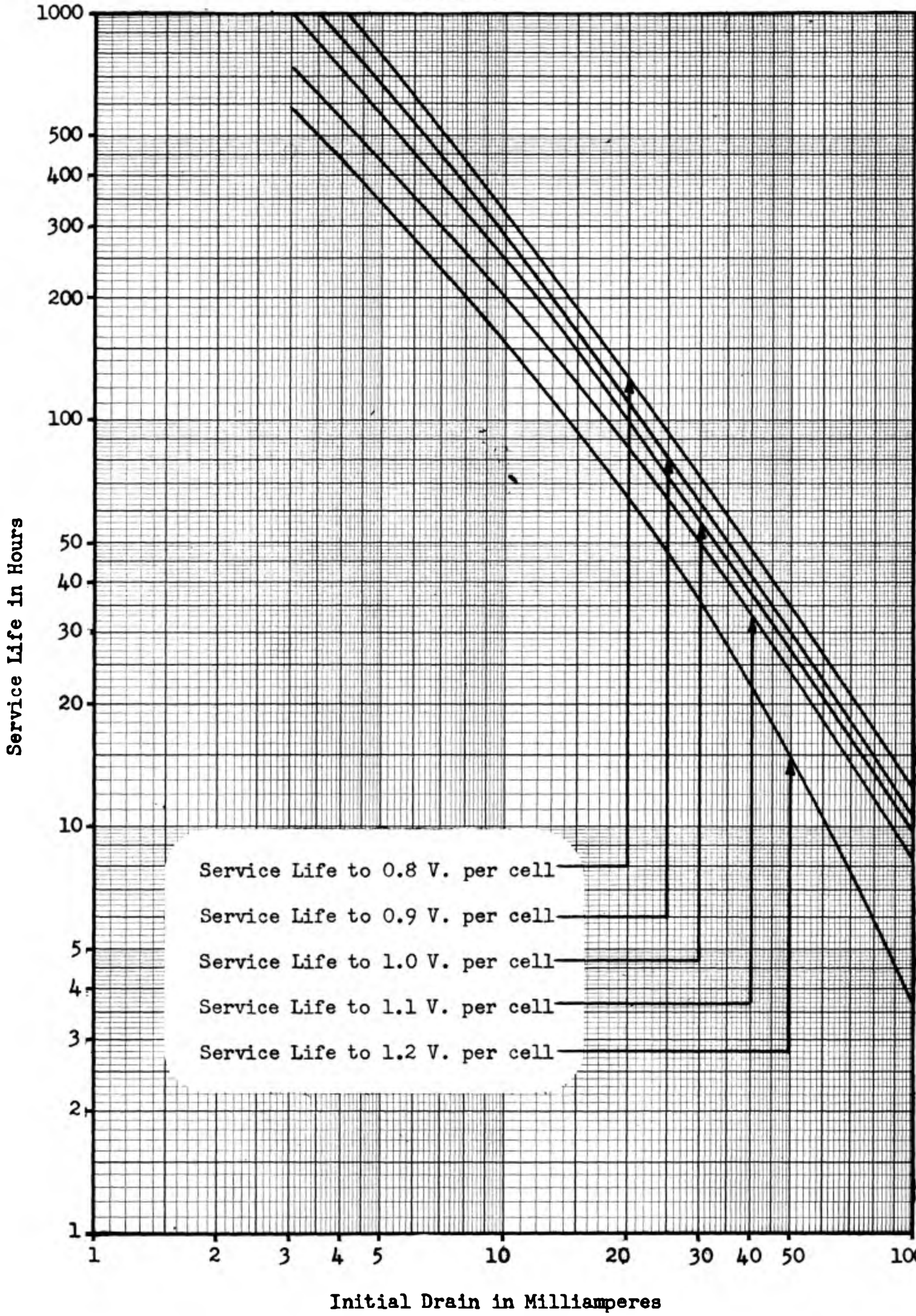


A-525

BURGESS

NUMBER 5 CELLS
(ASA Cell Size B)

Service Life When Discharged Continuously At 70° F.



5F-851

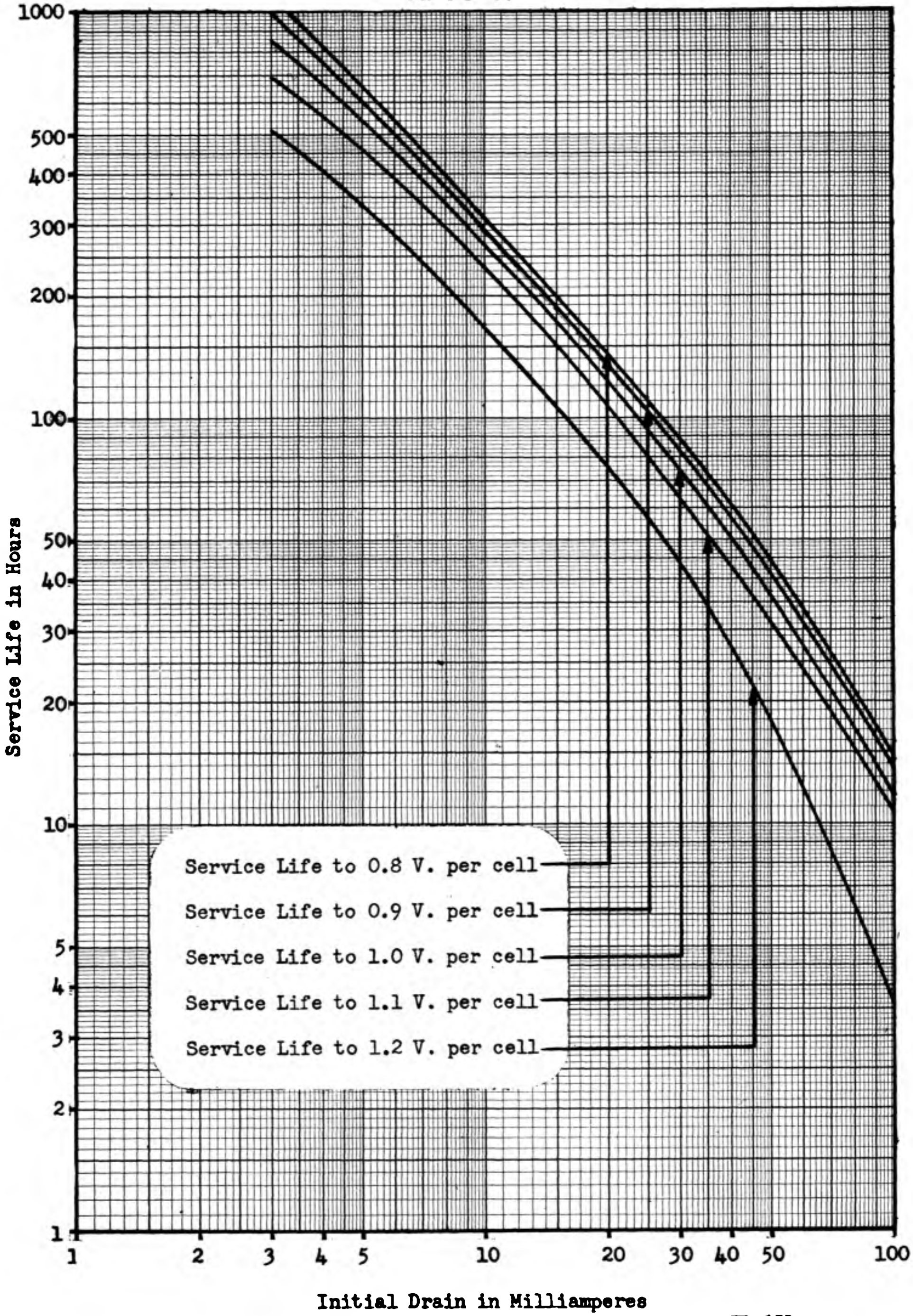
GRAPH NO.

27

BURGESS

NUMBER 5 CELLS
(ASA Cell Size B)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



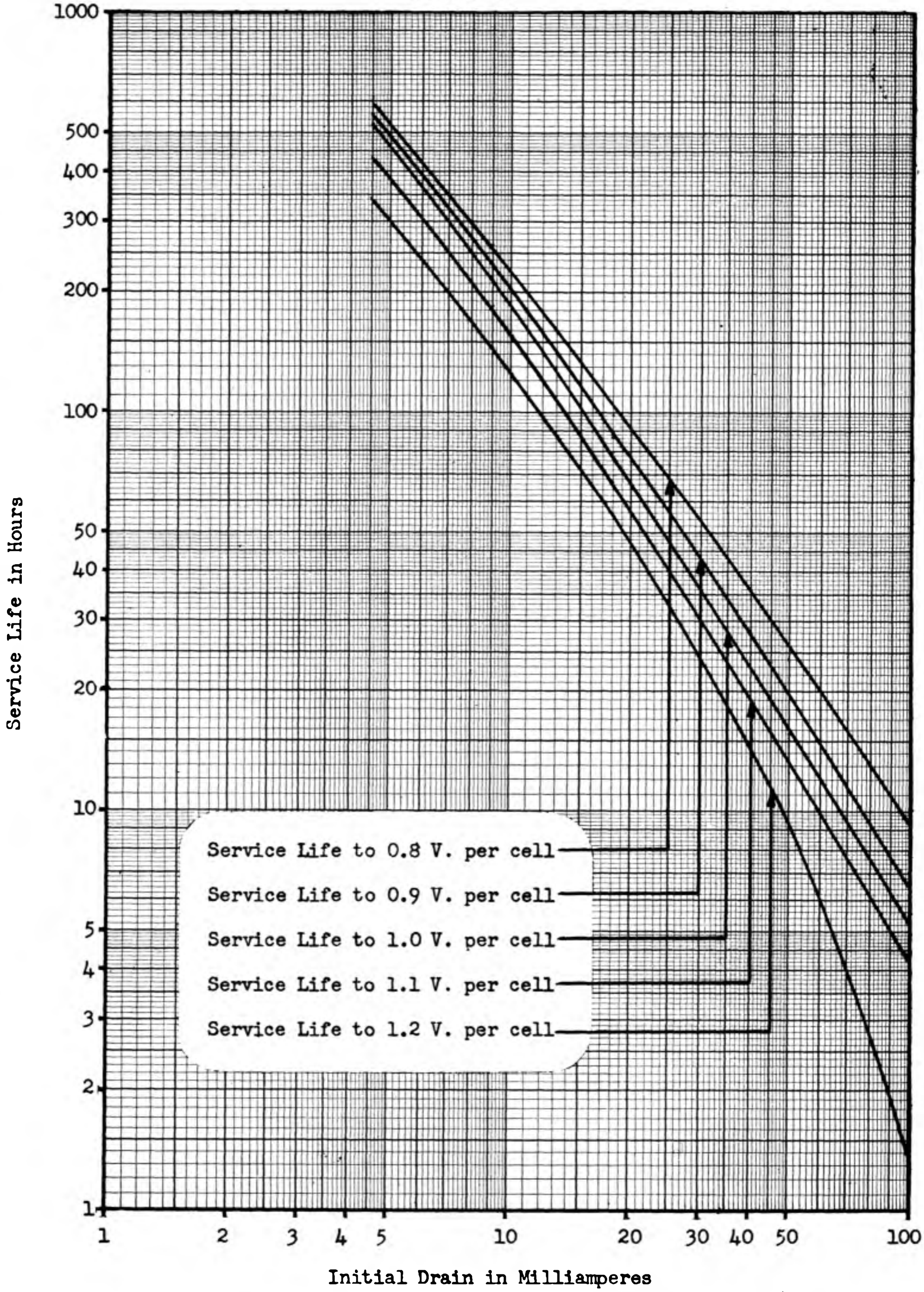
5F-851

BURGESS

GRAPH NO. 28

'M' CELLS
(ASA Cell Size F90)

Service Life When Discharged Continuously At 70° F.



MH-851

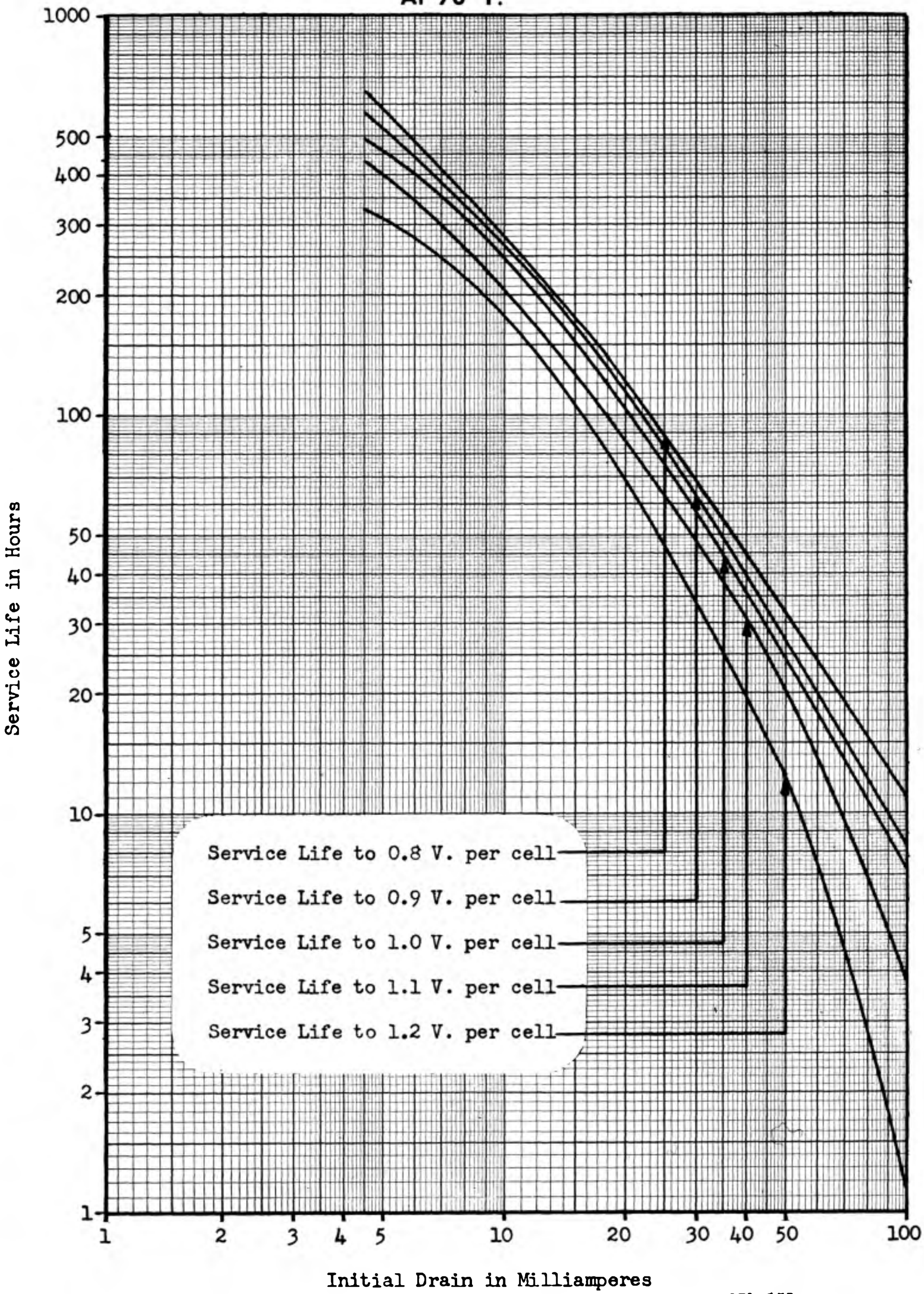
GRAPH NO.

29

BURGESS

'M' CELLS
(ASA Cell Size F90)

Service Life When
Discharged 4 Hrs. Per Day
At 70° F.



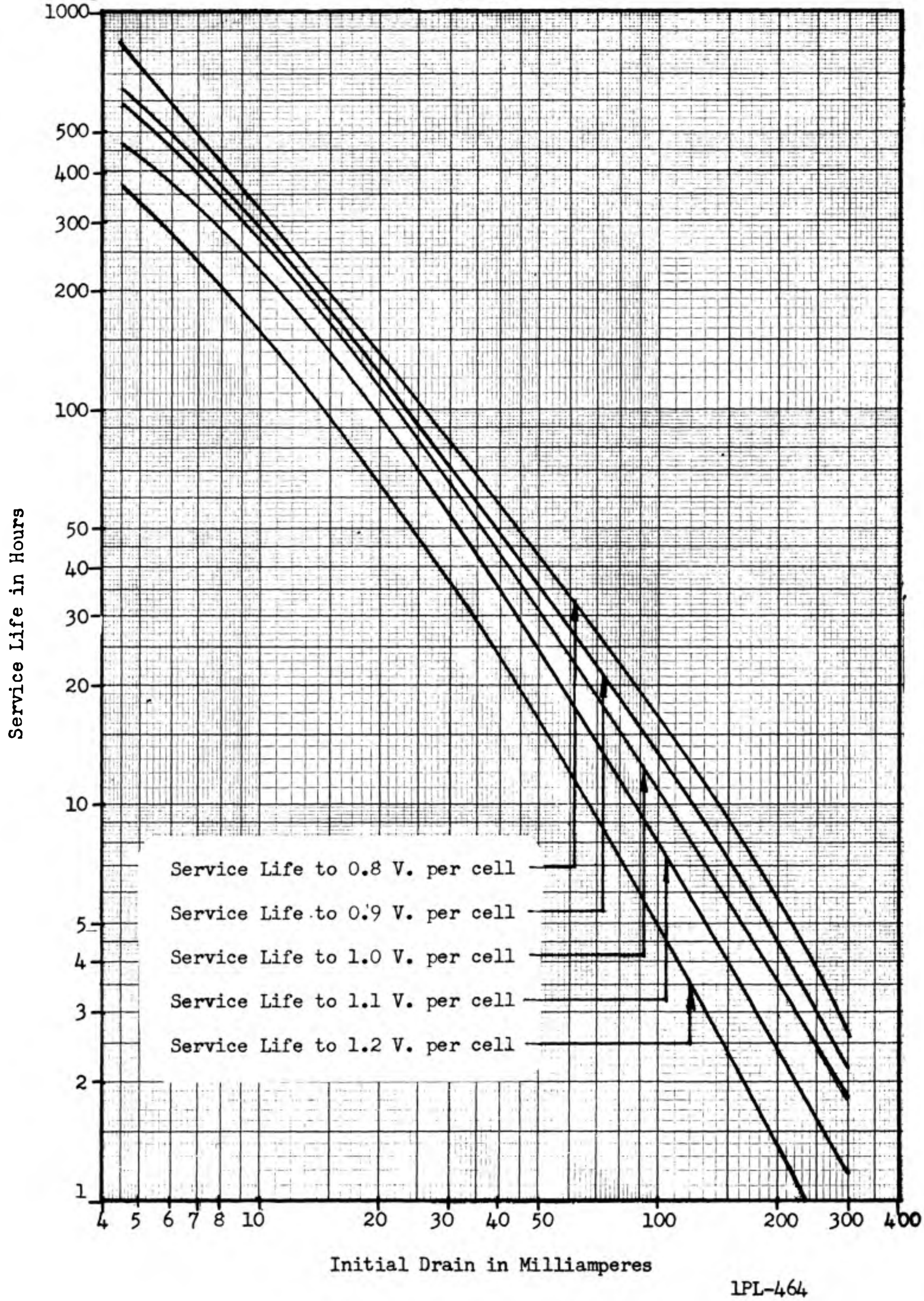
MH-851

BURGESS

GRAPH NO. 30

NUMBER 1 CELLS (ASA Cell Size C)

Service Life When Discharged Continuously At 70° F.



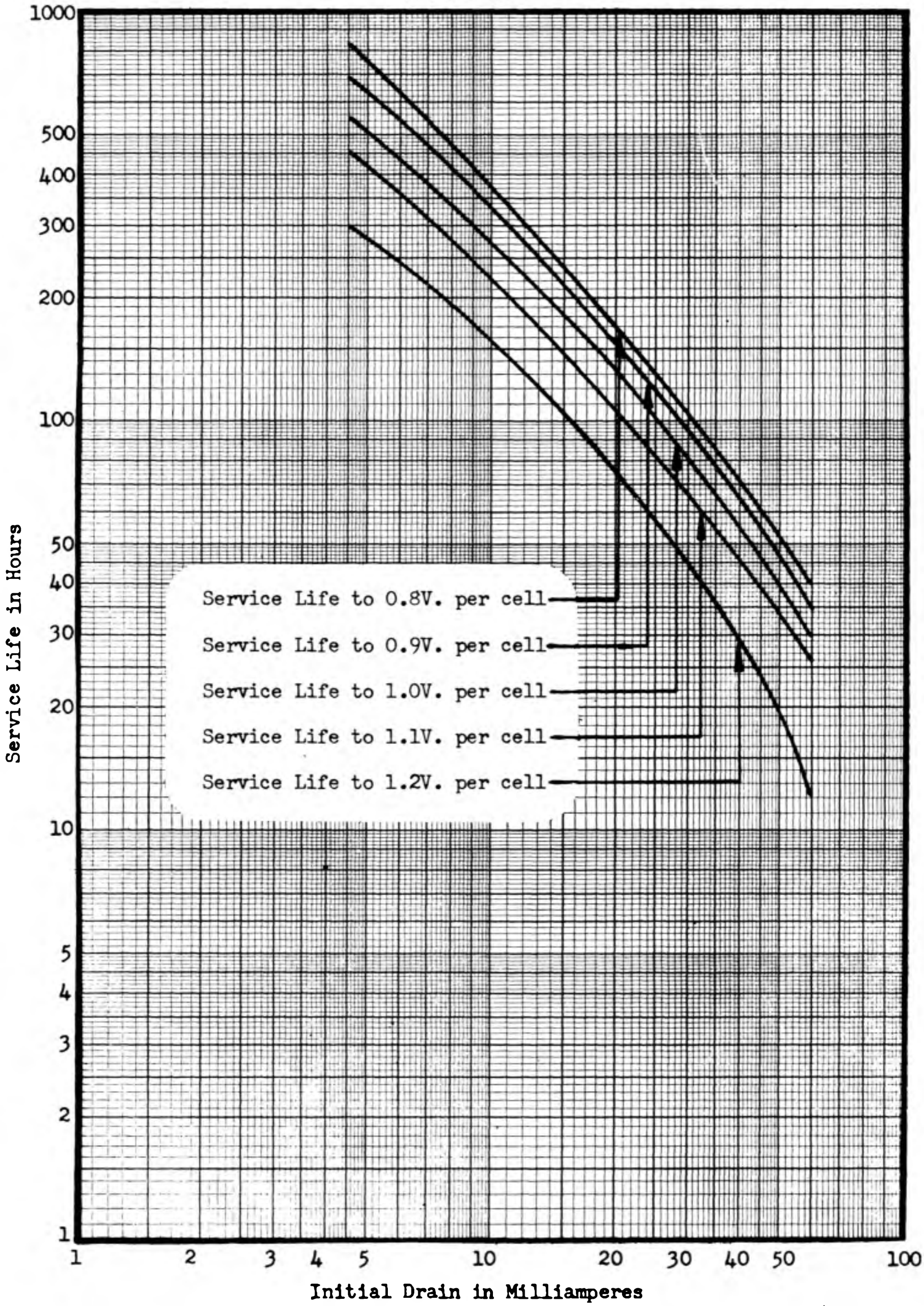
GRAPH NO.

31

BURGESS

NUMBER 1 CELLS
(ASA Cell Size C)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



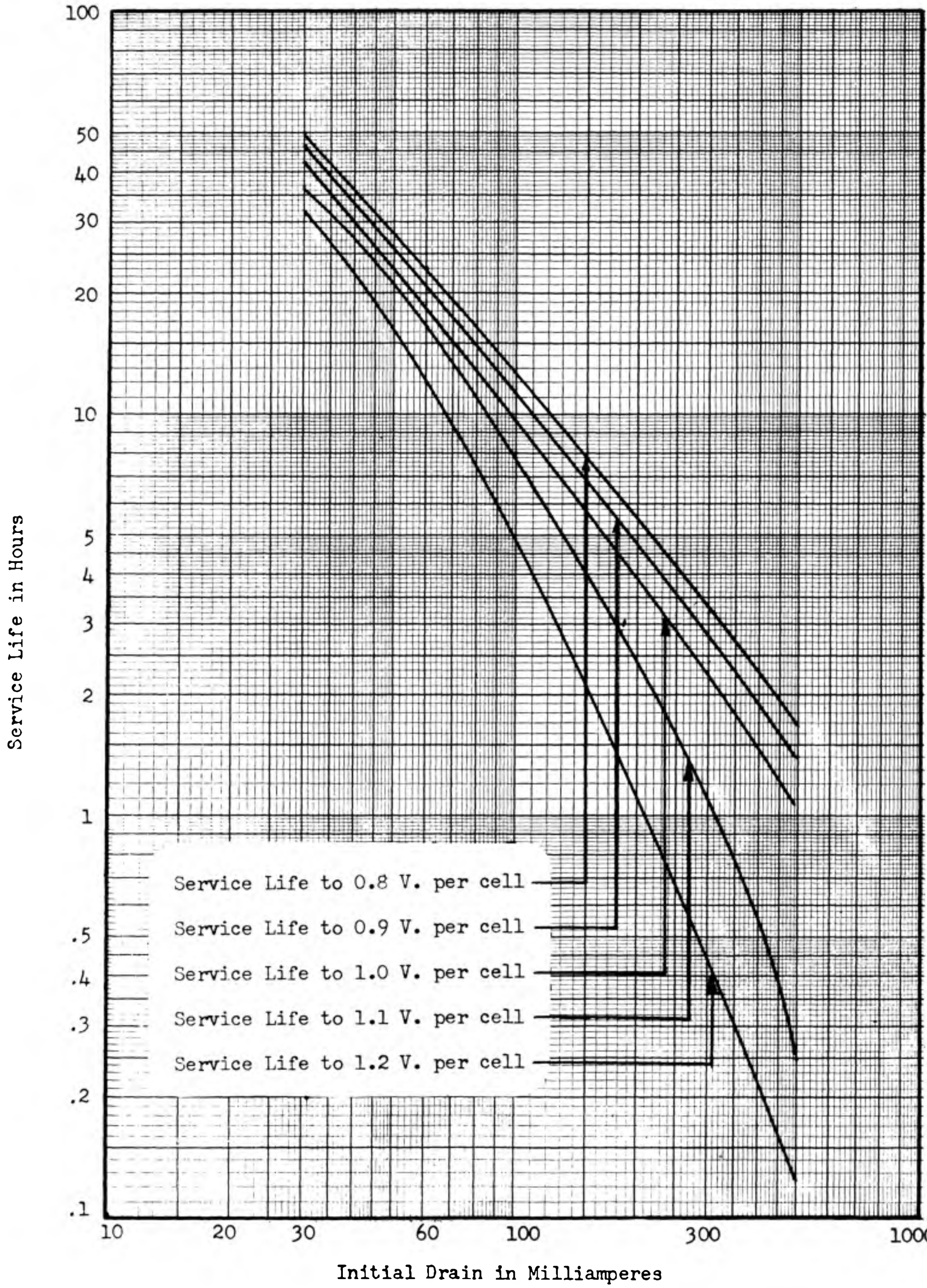
1PL-464

BURGESS

GRAPH NO. 32

NUMBER 120 CELLS
(ASA Cell Size C)

Service Life When Discharged Continuously At 70° F.



C-525

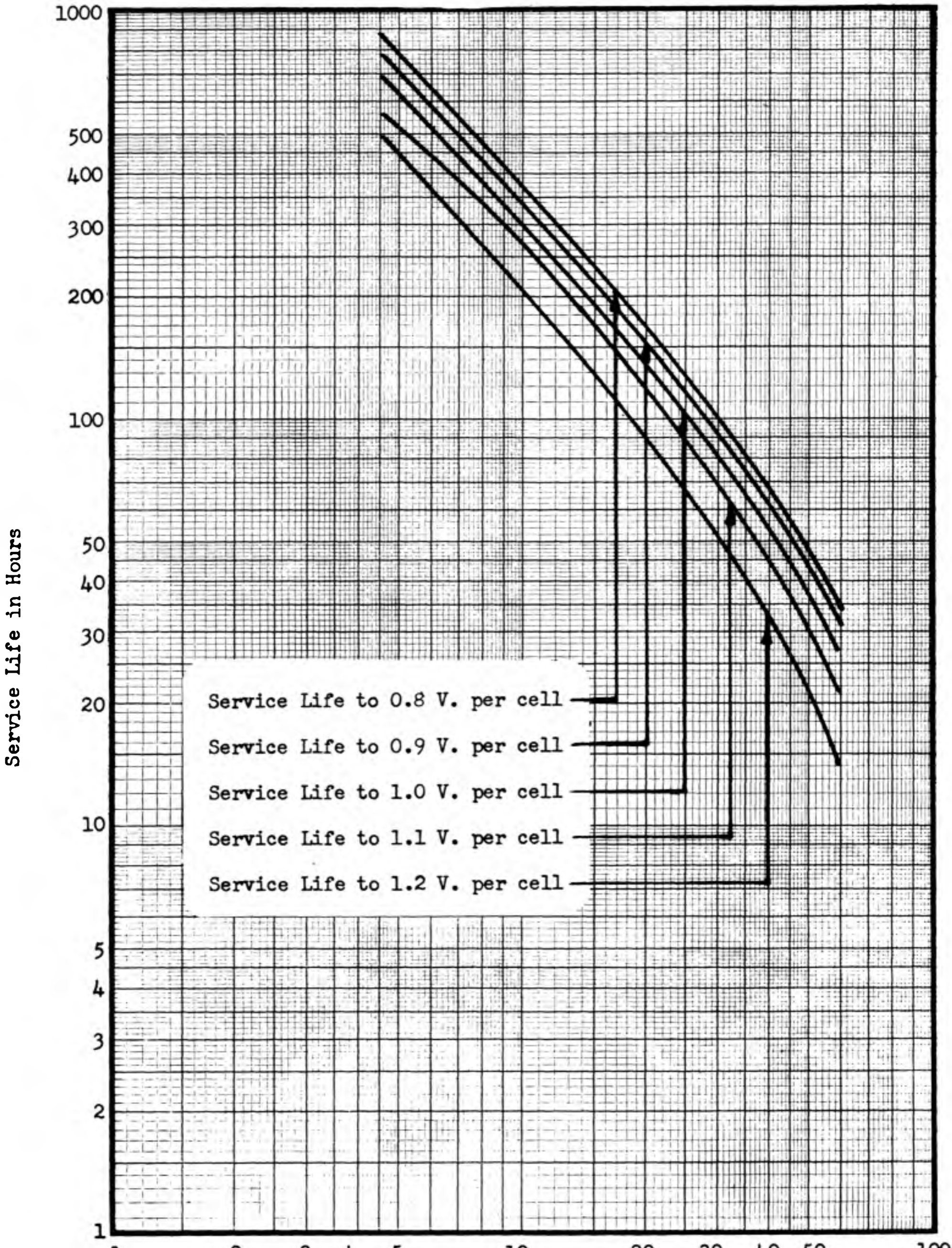
GRAPH NO.

33

BURGESS

NUMBER 130 CELLS
(ASA Cell Size C)

Service Life When Discharged Continuously At 70° F.



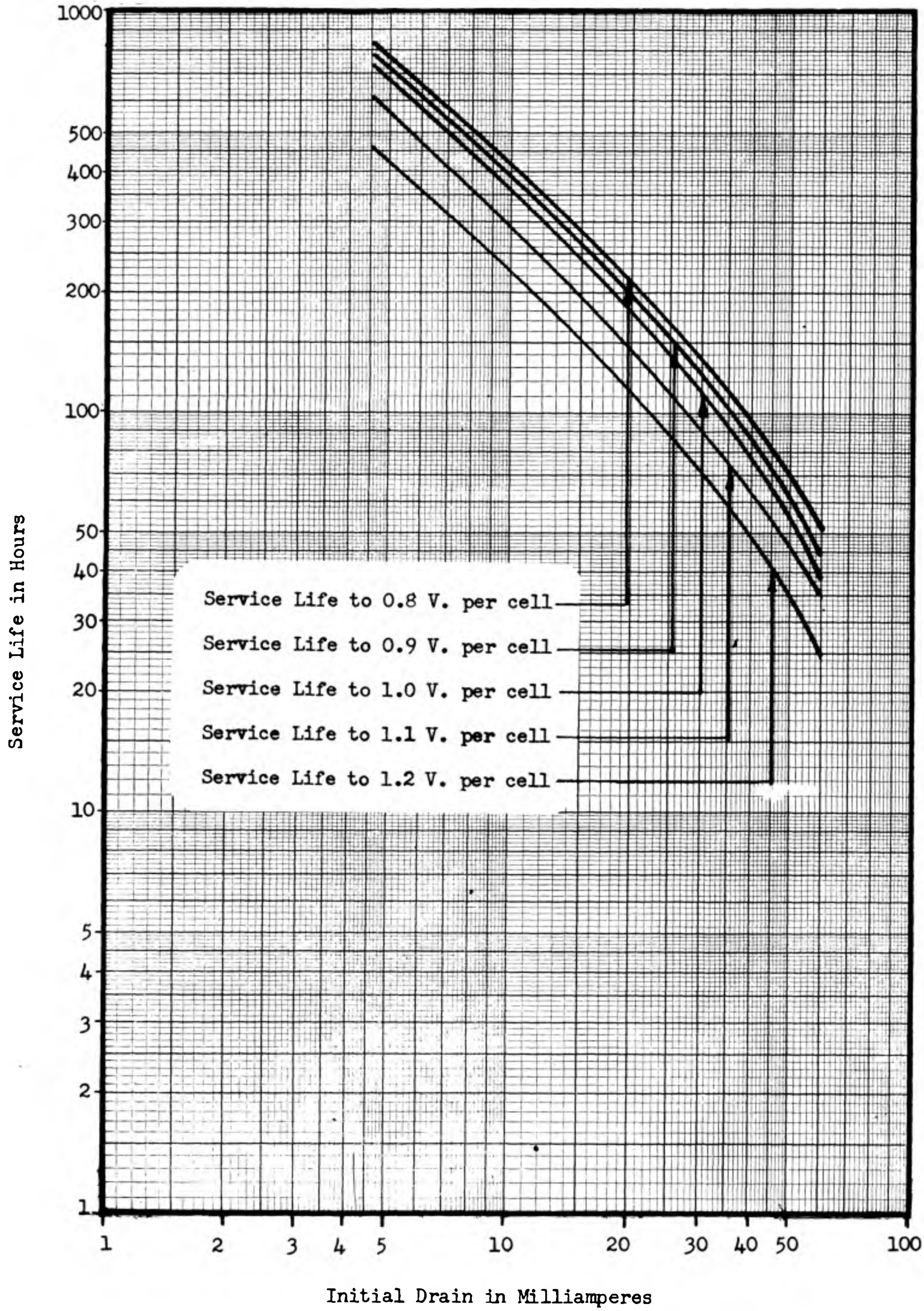
Initial Drain in Milliamperes

C-525

BURGESS GRAPH NO. 34

NUMBER 130 CELLS
(ASA Cell Size C)

Service Life When
Discharged 4 Hrs. Per Day
At 70° F.



C-525

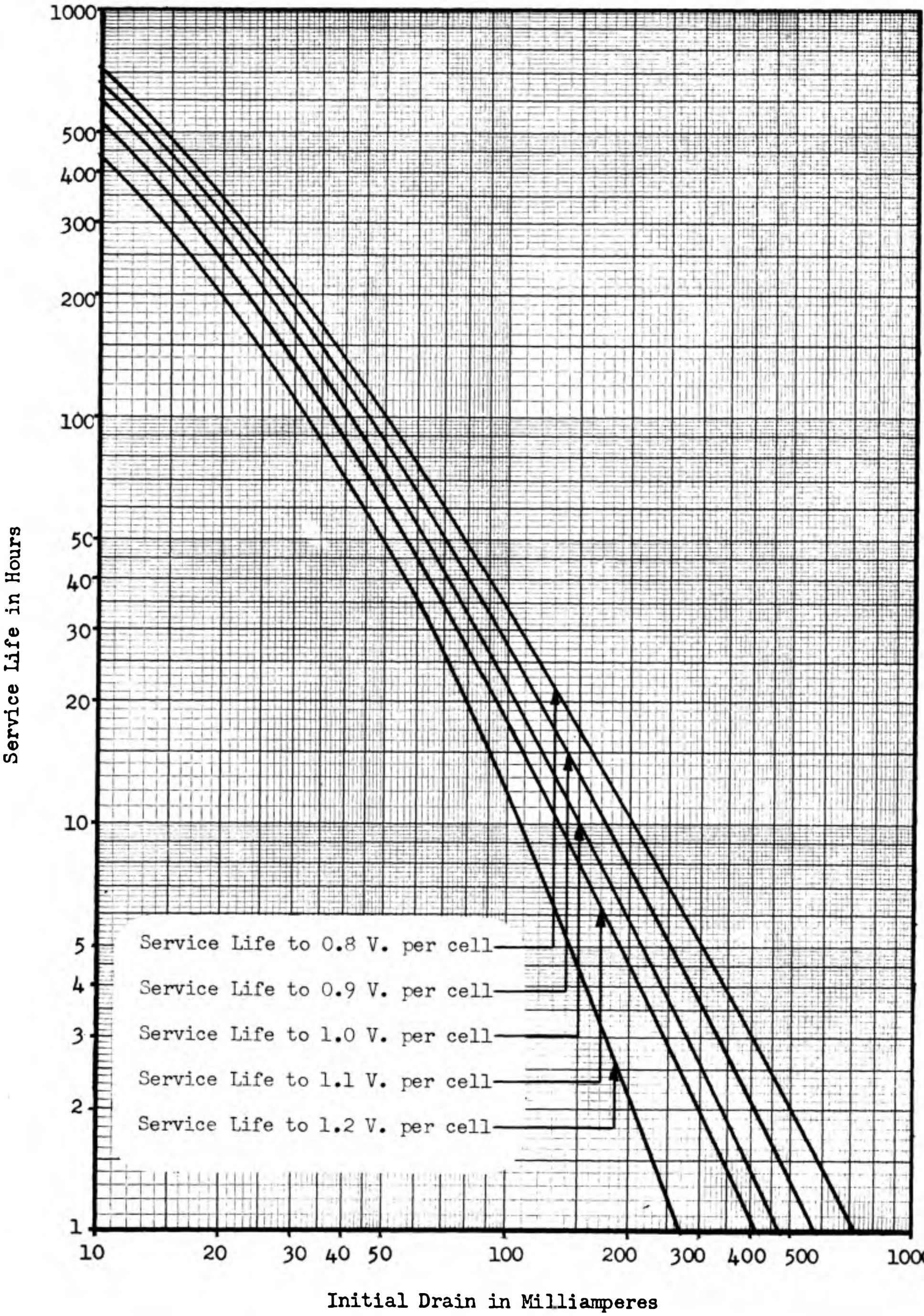
GRAPH NO.

35

BURGESS

NUMBER 8 CELLS
(ASA Cell Size CD)

Service Life When Discharged Continuously At 70° F.



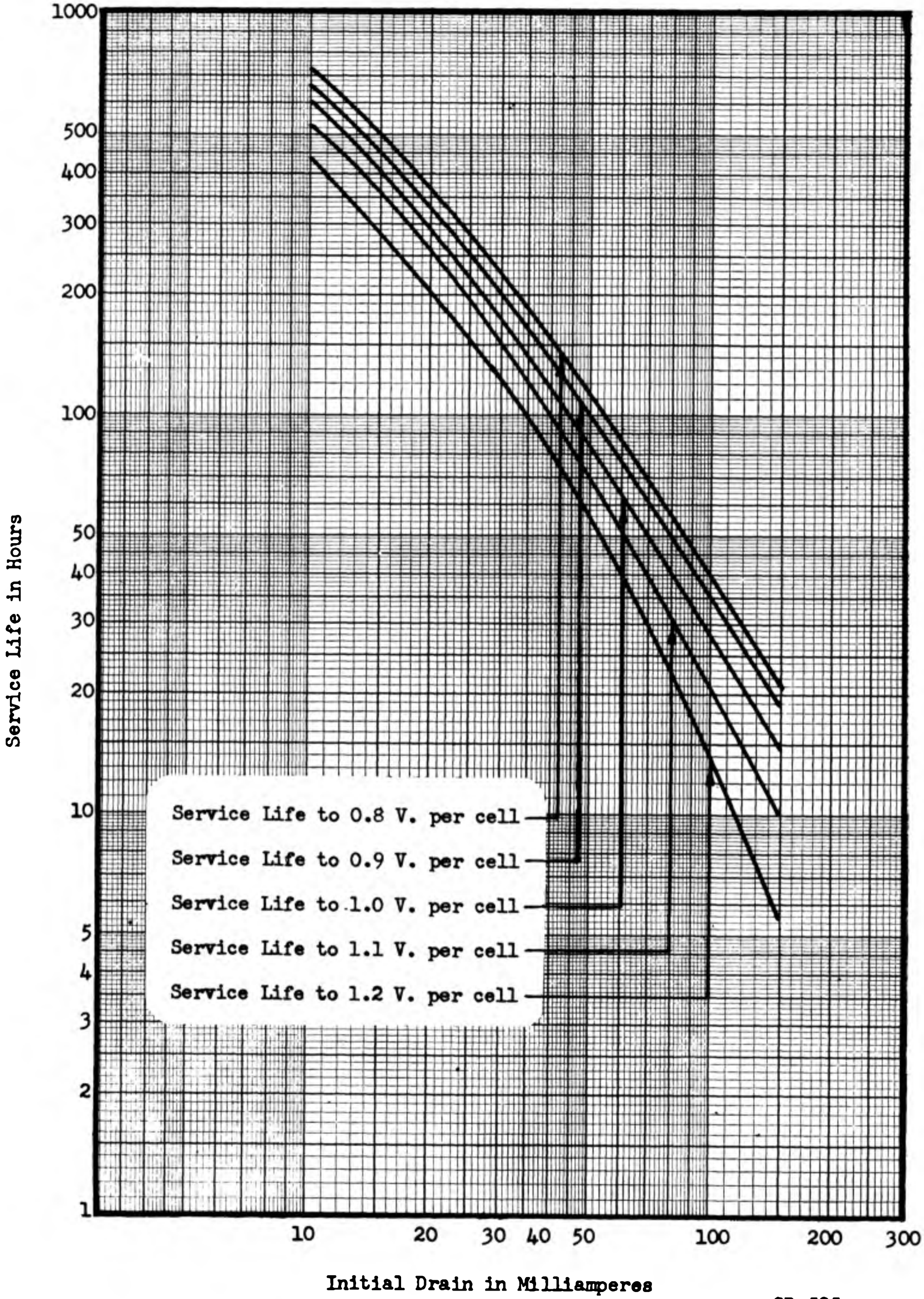
CD-525

BURGESS

GRAPH NO. 36

NUMBER 8 CELLS
(ASA Cell Size CD)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



CD-525

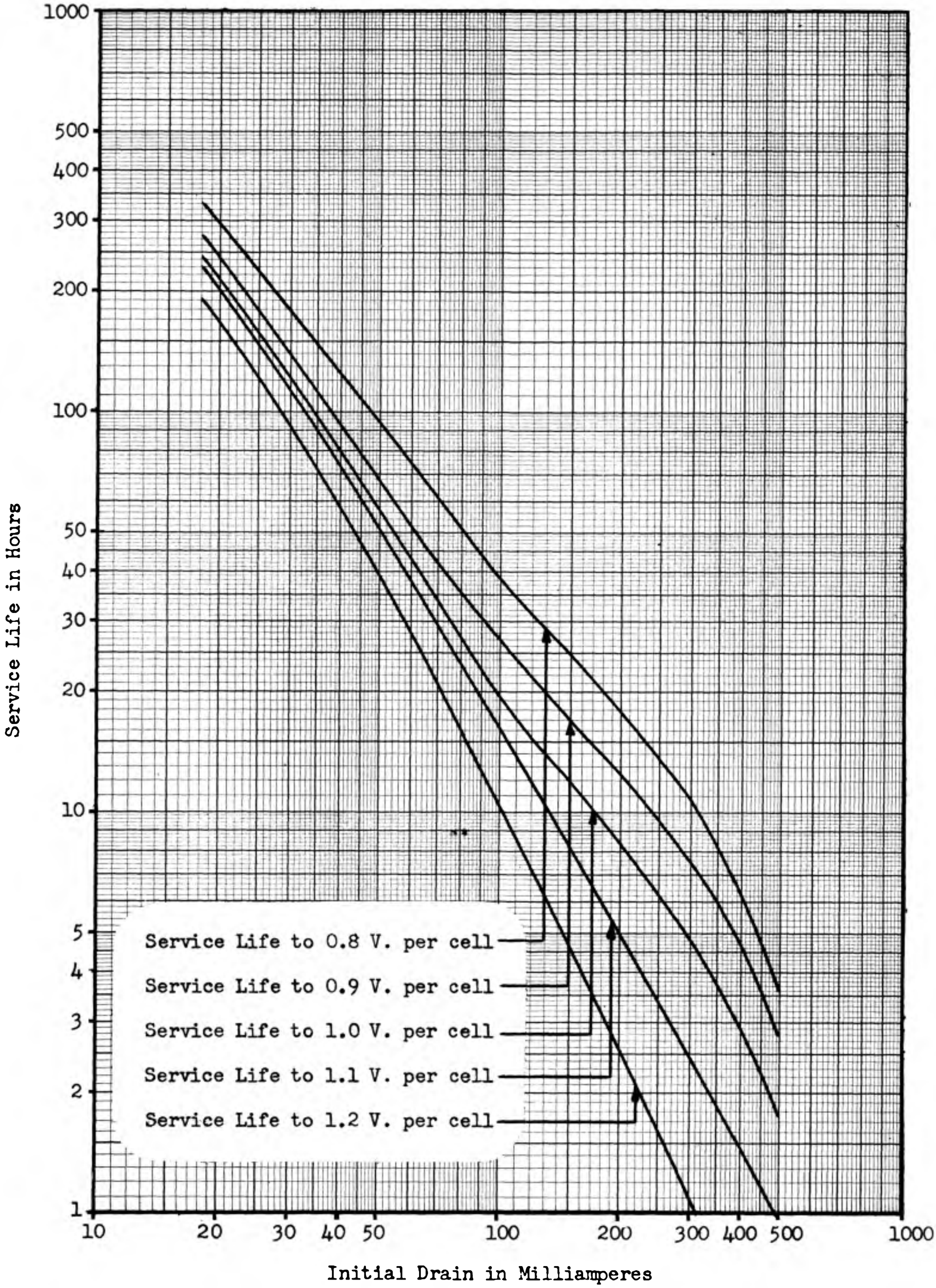
GRAPH NO.

37

BURGESS

NUMBER 2 CELLS
(ASA Cell Size D)

Service Life When Discharged Continuously At 70° F.



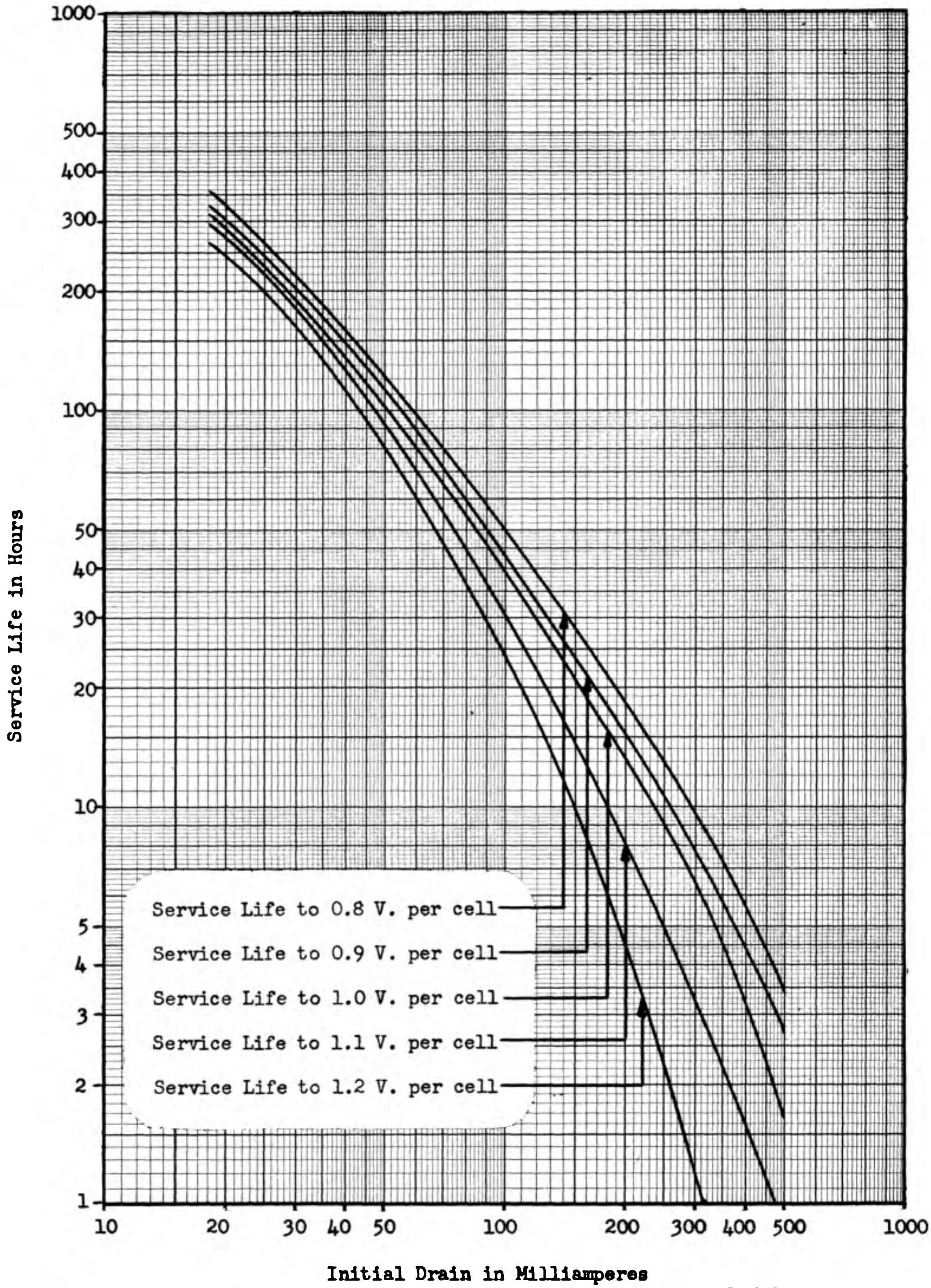
D-851

BURGESS

GRAPH NO. 38

NUMBER 2 CELLS
(ASA Cell Size D)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



D-851

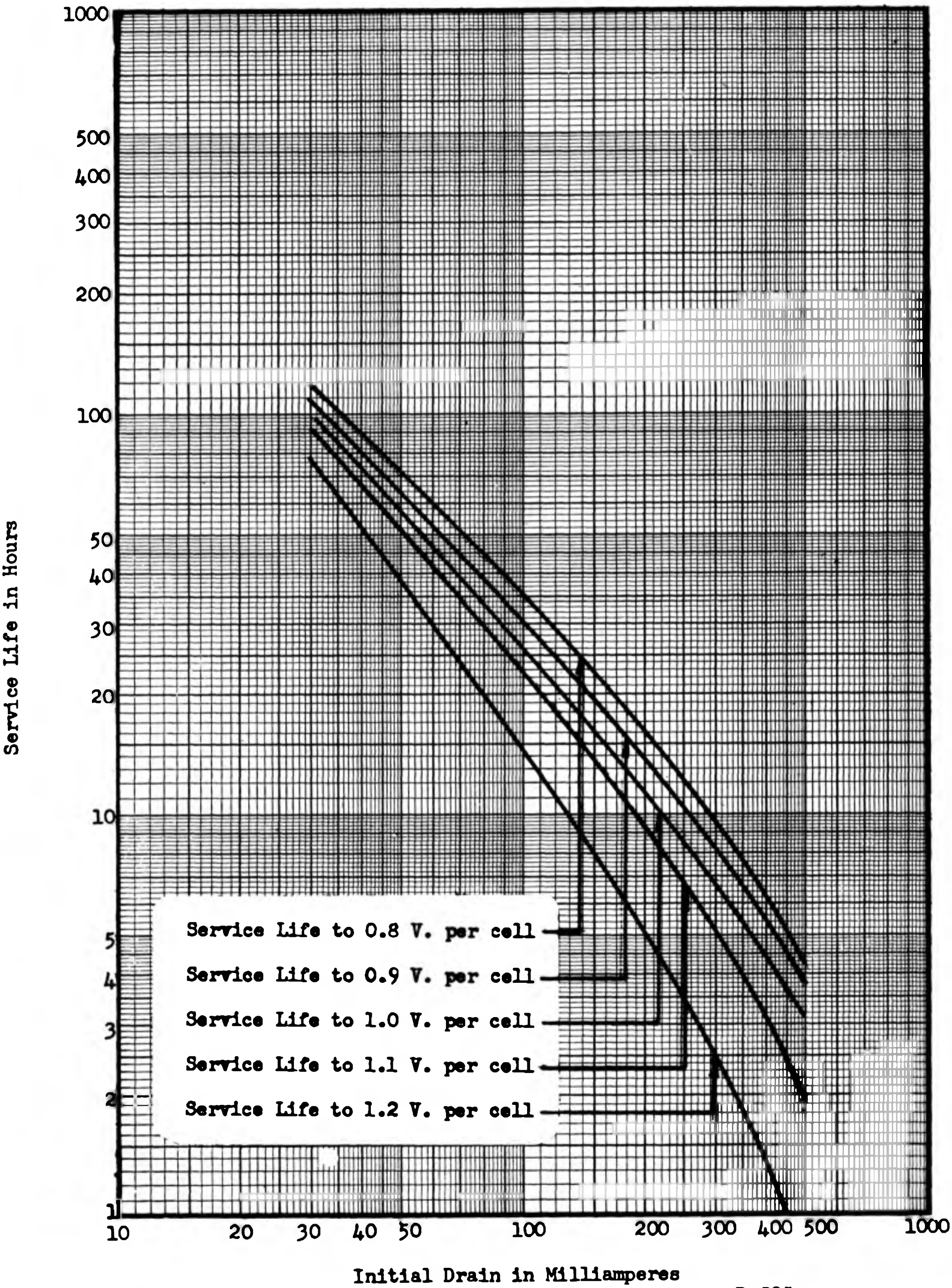
GRAPH NO.

39

BURGESS

NUMBER 220 CELLS (ASA Cell Size D)

Service Life When Discharged Continuously At 70° F.



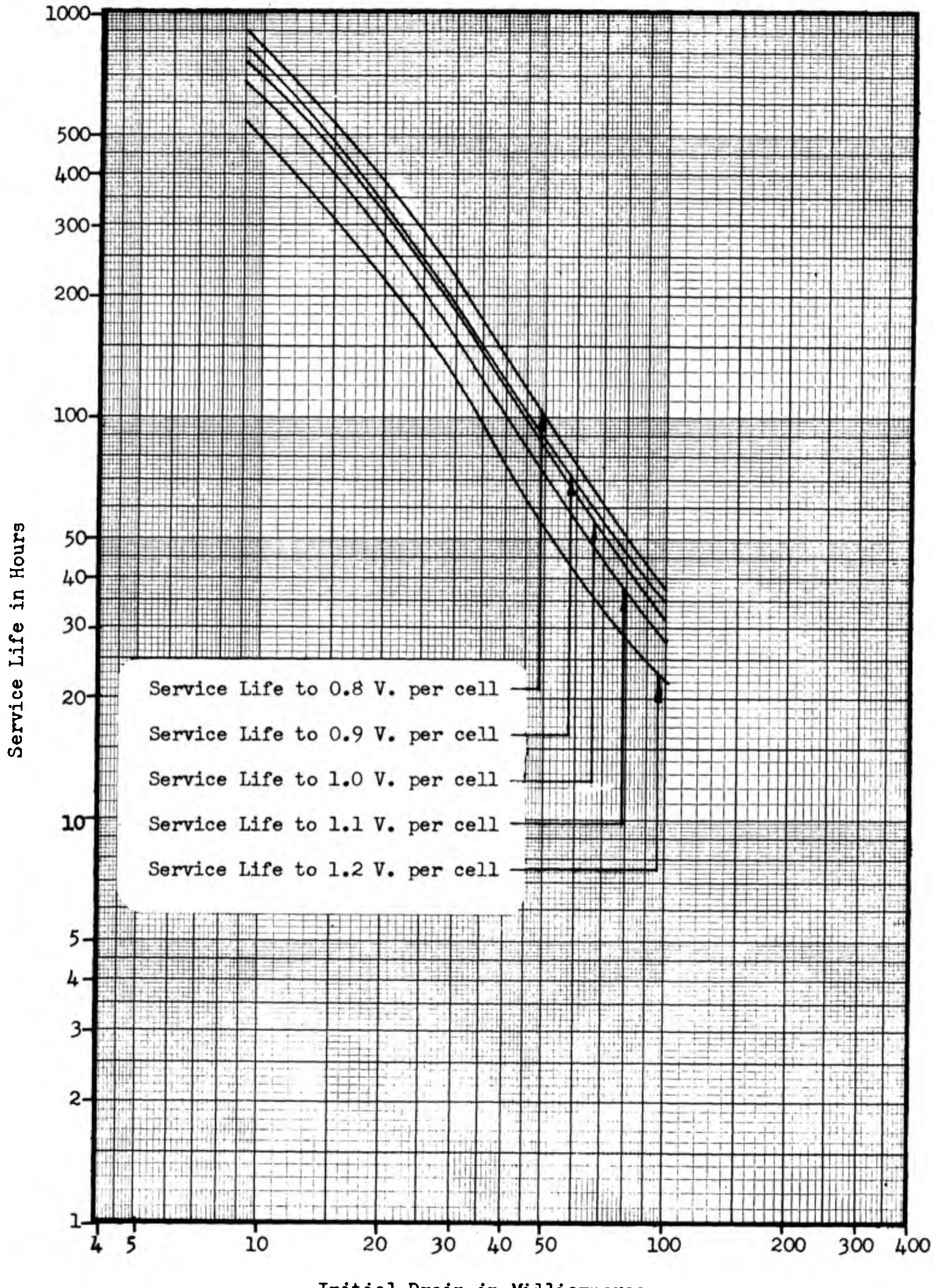
D-525

BURGESS

NUMBER 230 CELLS
(ASA Cell Size D)

GRAPH NO. 40

Service Life When
Discharged Continuously
At 70° F.



D-525

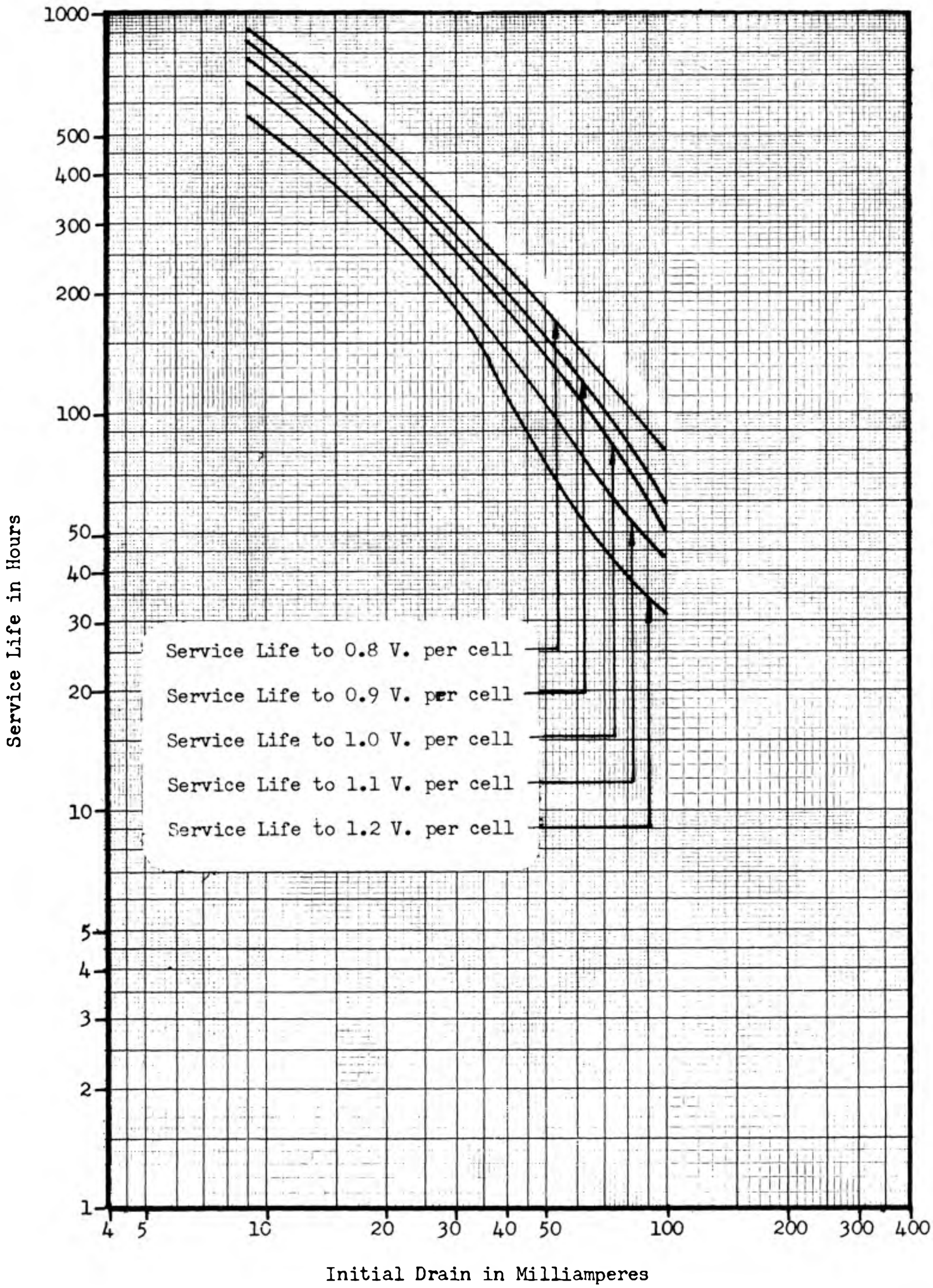
GRAPH NO.

41

BURGESS

NUMBER 230 CELLS
(ASA Cell Size D)

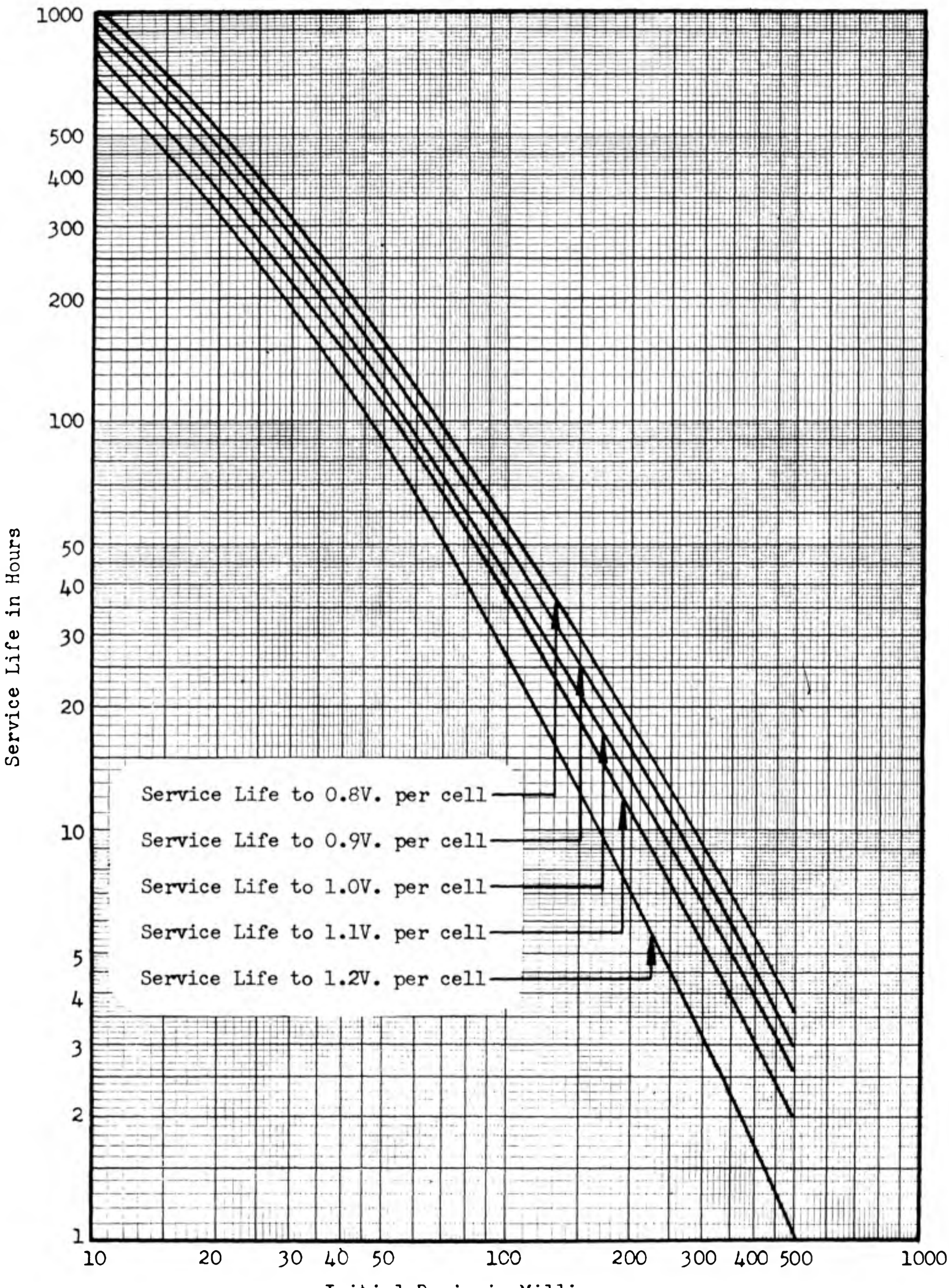
Service Life When Discharged 4 Hrs. Per Day At 70° F.



BURGESS

NUMBER 210 CELLS
(ASA Cell Size D)

Service Life When Discharged Continuously At 70° F.



D-466

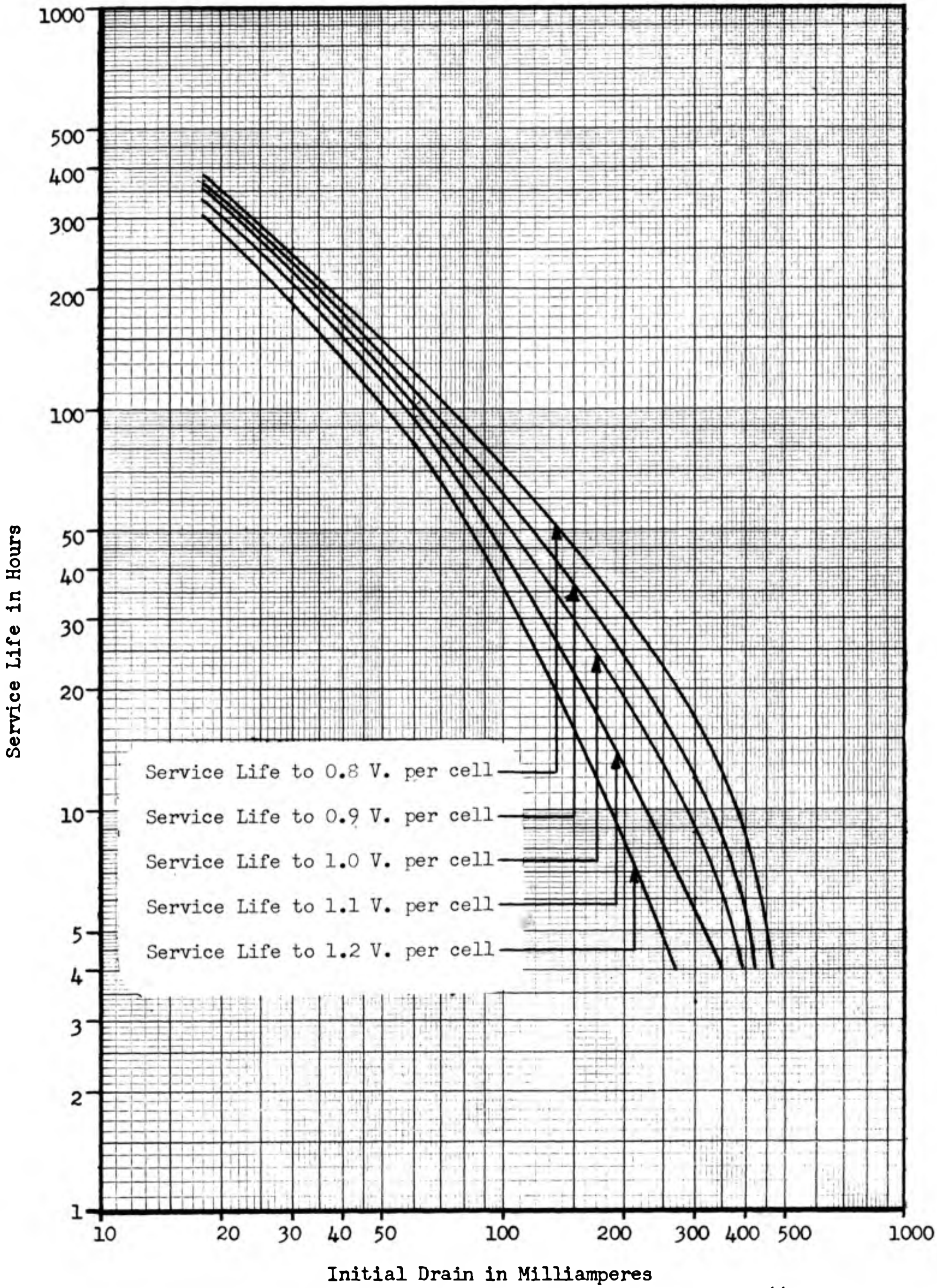
GRAPH NO.

43

BURGESS

NUMBER 210 CELLS
(ASA Cell Size D)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



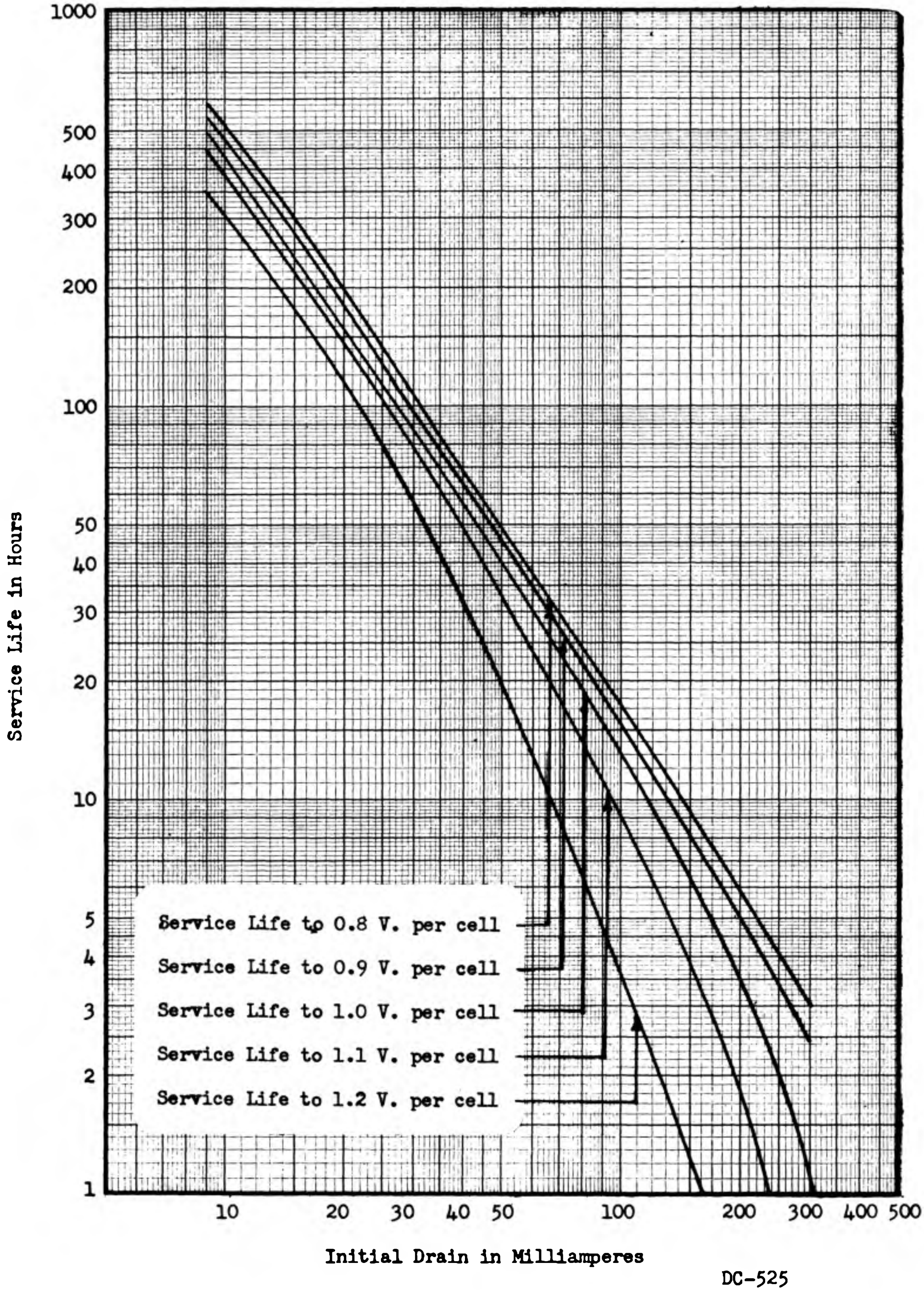
D-466

BURGESS

'DC' CELLS

GRAPH NO. 44

Service Life When Discharged Continuously At 70° F.



DC-525

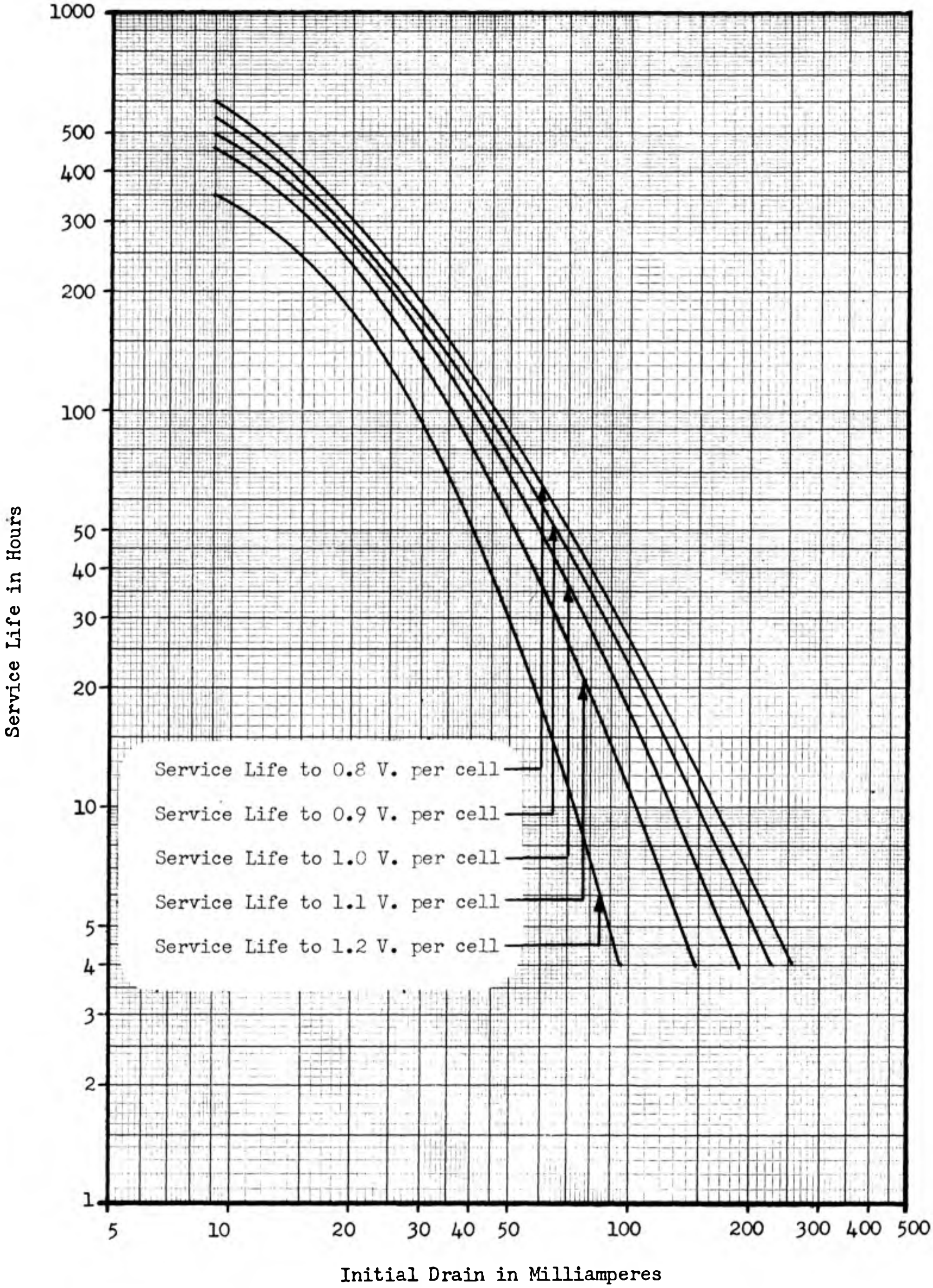
GRAPH NO.

45

BURGESS

'DC' CELLS

Service Life When Discharged 4 Hrs. Per Day At 70° F.



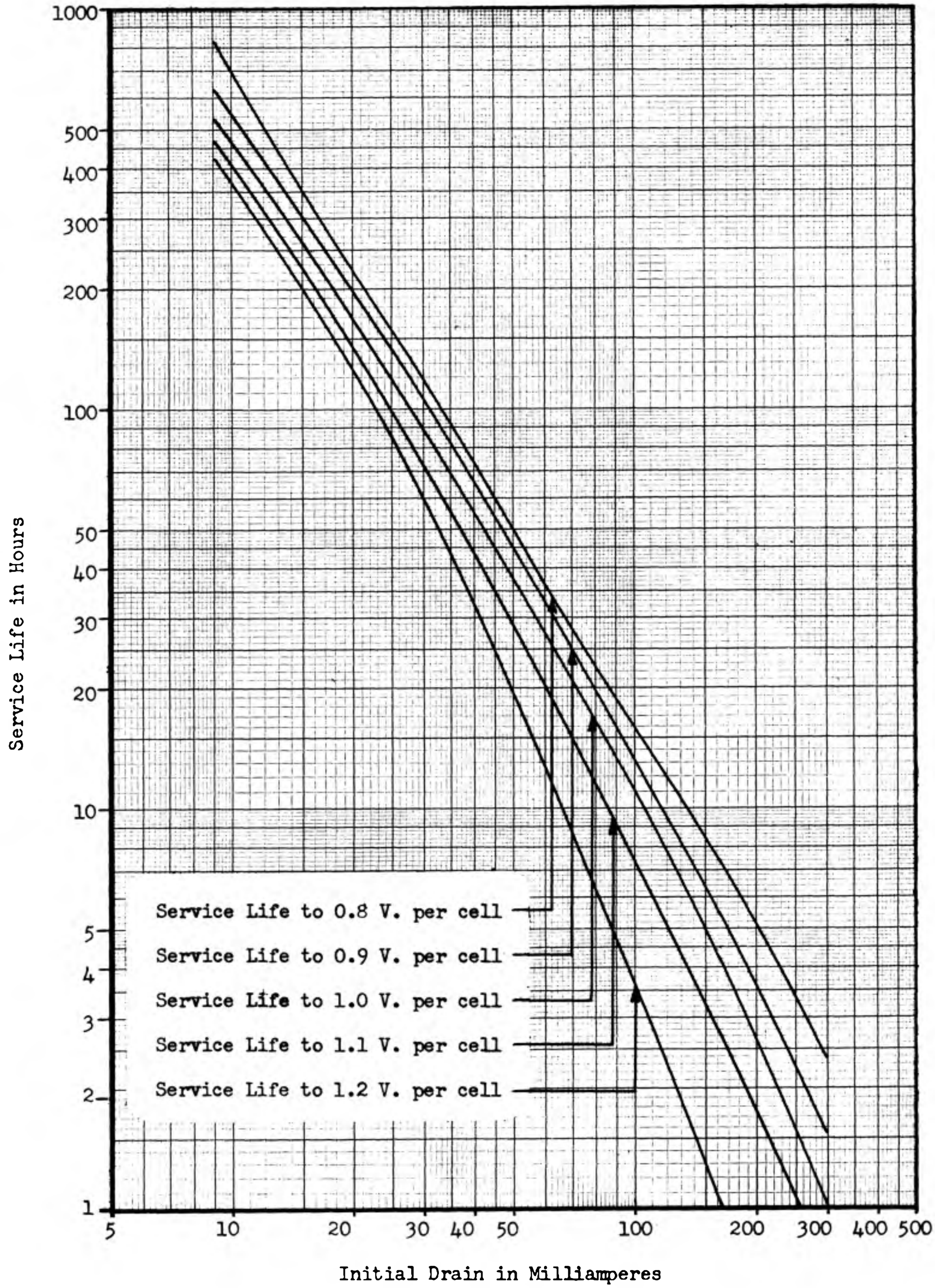
DC-525

BURGESS

GRAPH NO. 46

'DH' CELLS
(ASA CELLS F100)

Service Life When Discharged Continuously At 70° F.



DH-525

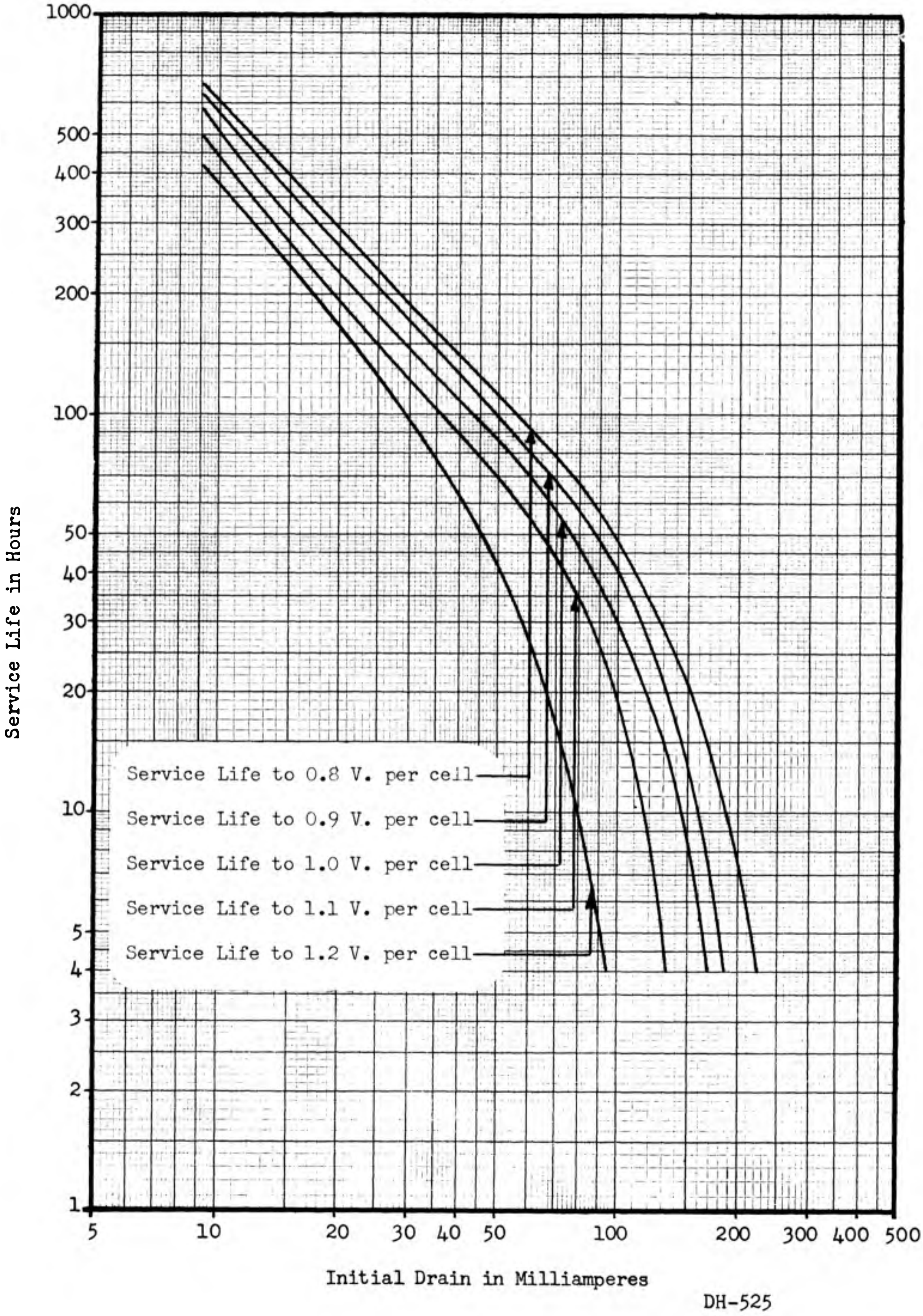
GRAPH NO.

47

BURGESS

'DH' CELLS
(ASA CELLS F100)

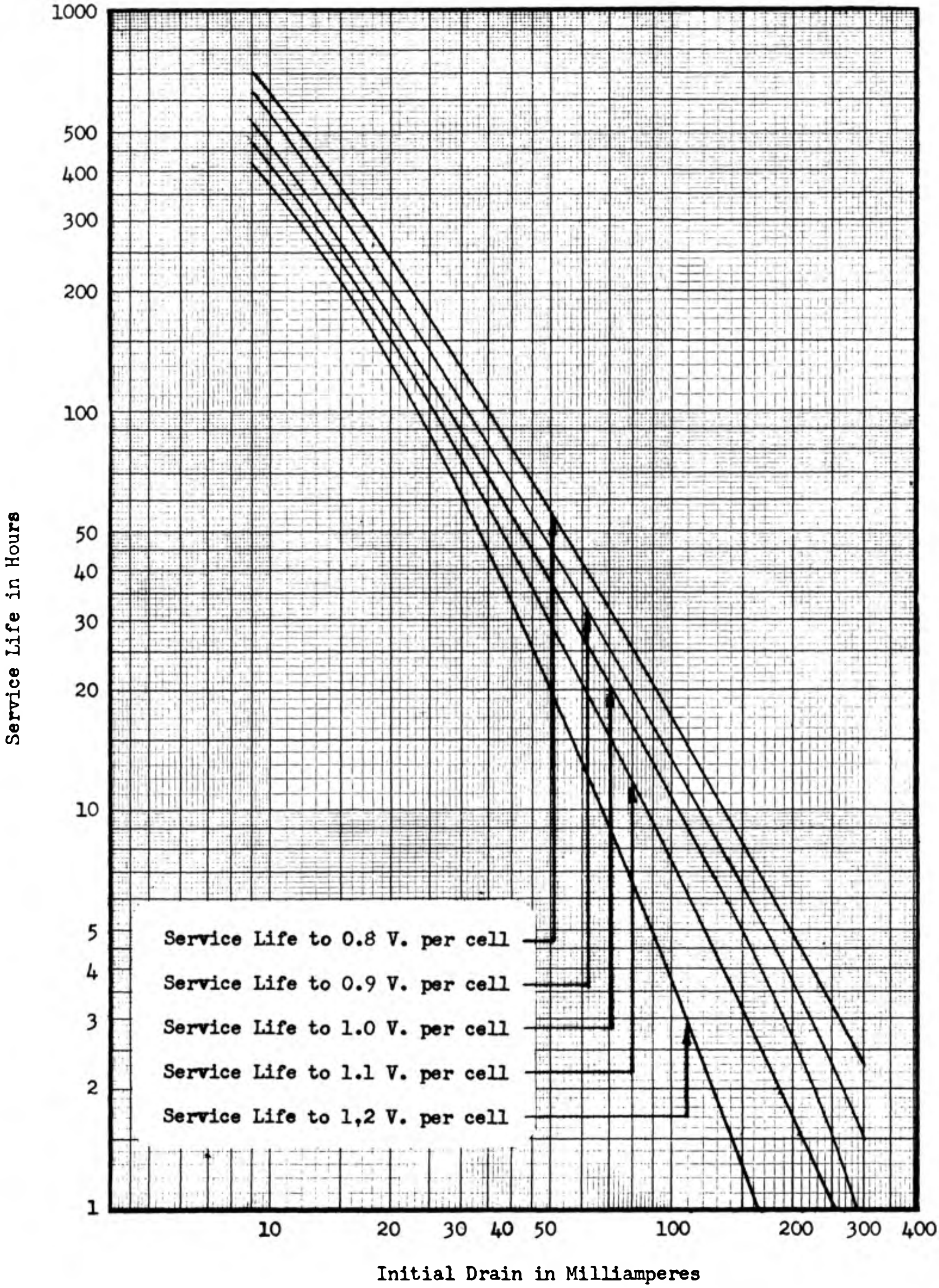
Service Life When Discharged 4 Hrs. Per Day At 70° F.



BURGESS **GRAPH NO. 48**

'D' CELLS
(ASA CELLS F100)

Service Life When Discharged Continuously At 70° F.



D-525

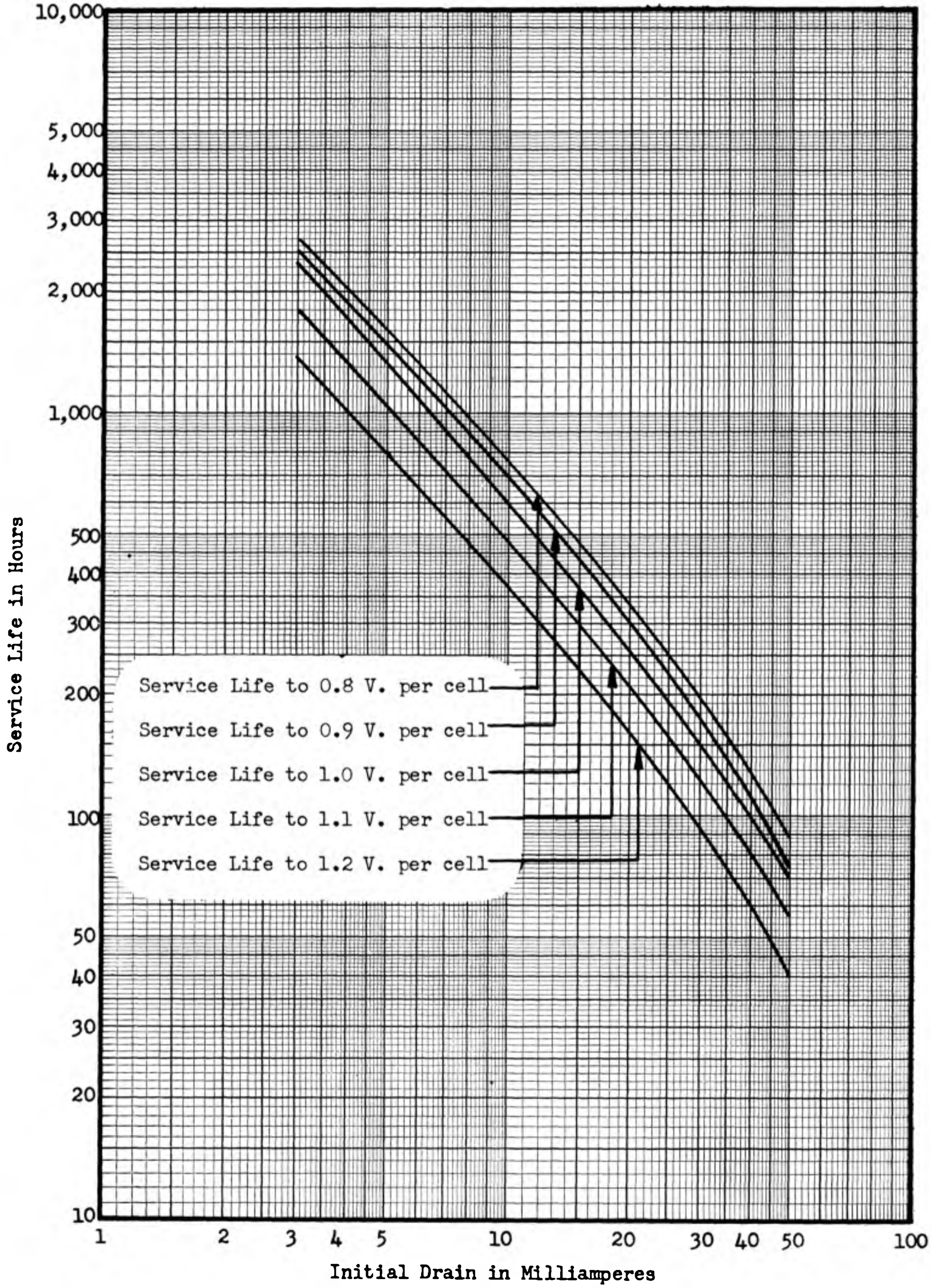
GRAPH NO.

49

BURGESS

'D' CELLS
(ASA CELLS F100)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



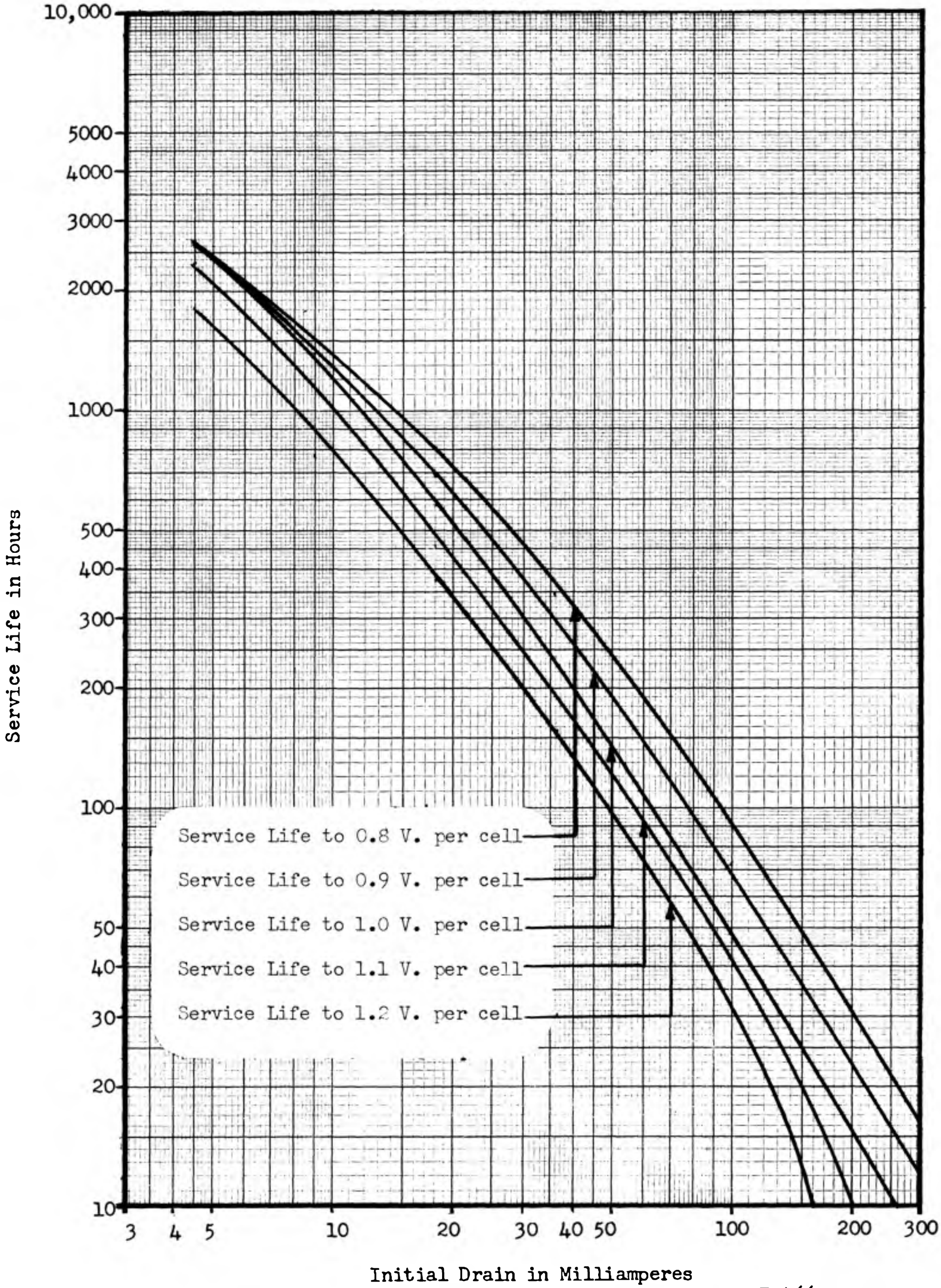
DF-402

BURGESS

GRAPH NO. 50

NUMBER 10 CELLS (ASA Cell Size F)

Service Life When Discharged Continuously At 70° F.



F-466

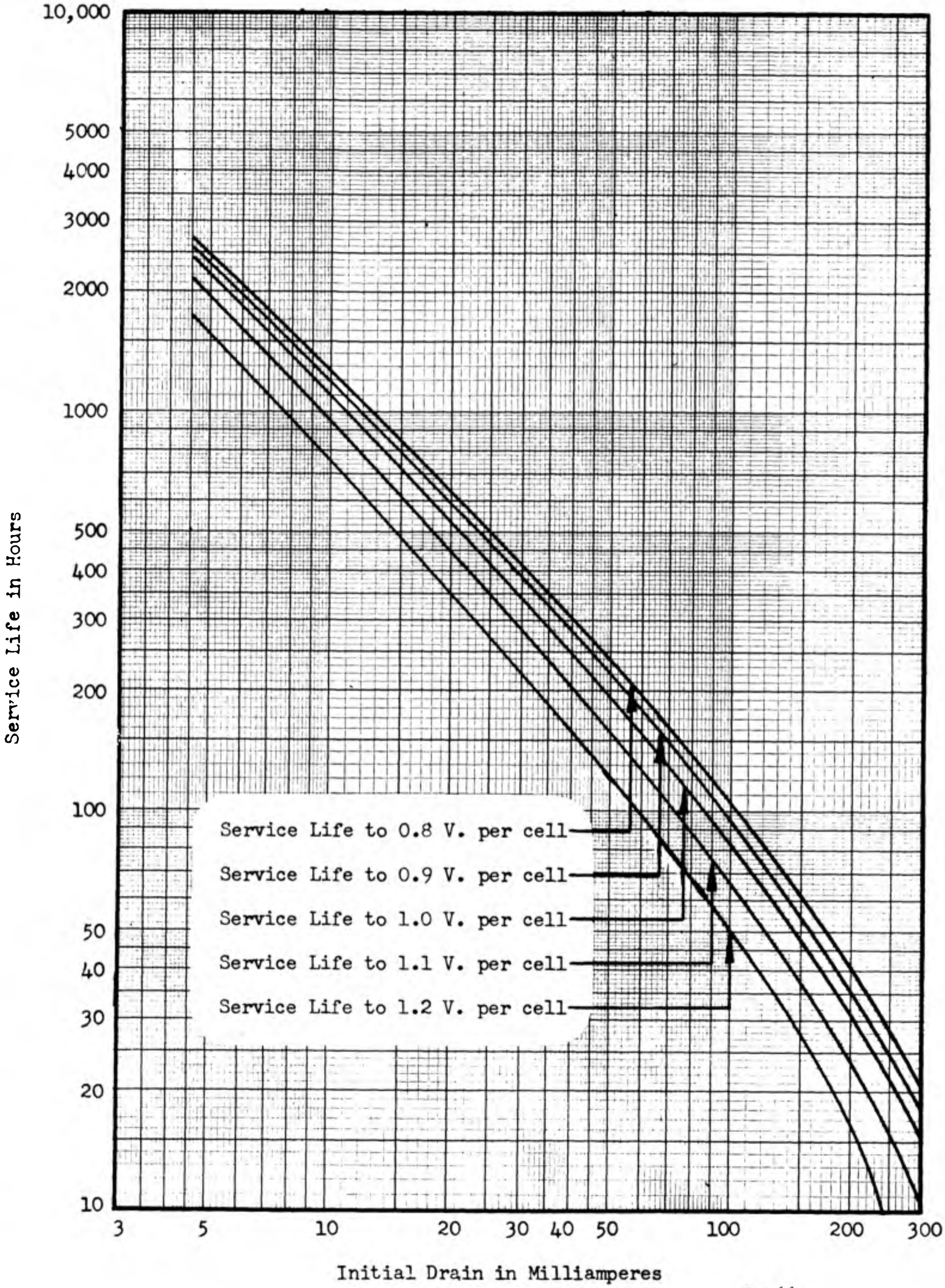
GRAPH NO.

51

BURGESS

NUMBER 10 CELLS
(ASA Cell Size F)

Service Life When Discharged 4 Hrs. Per Day At 70° F.

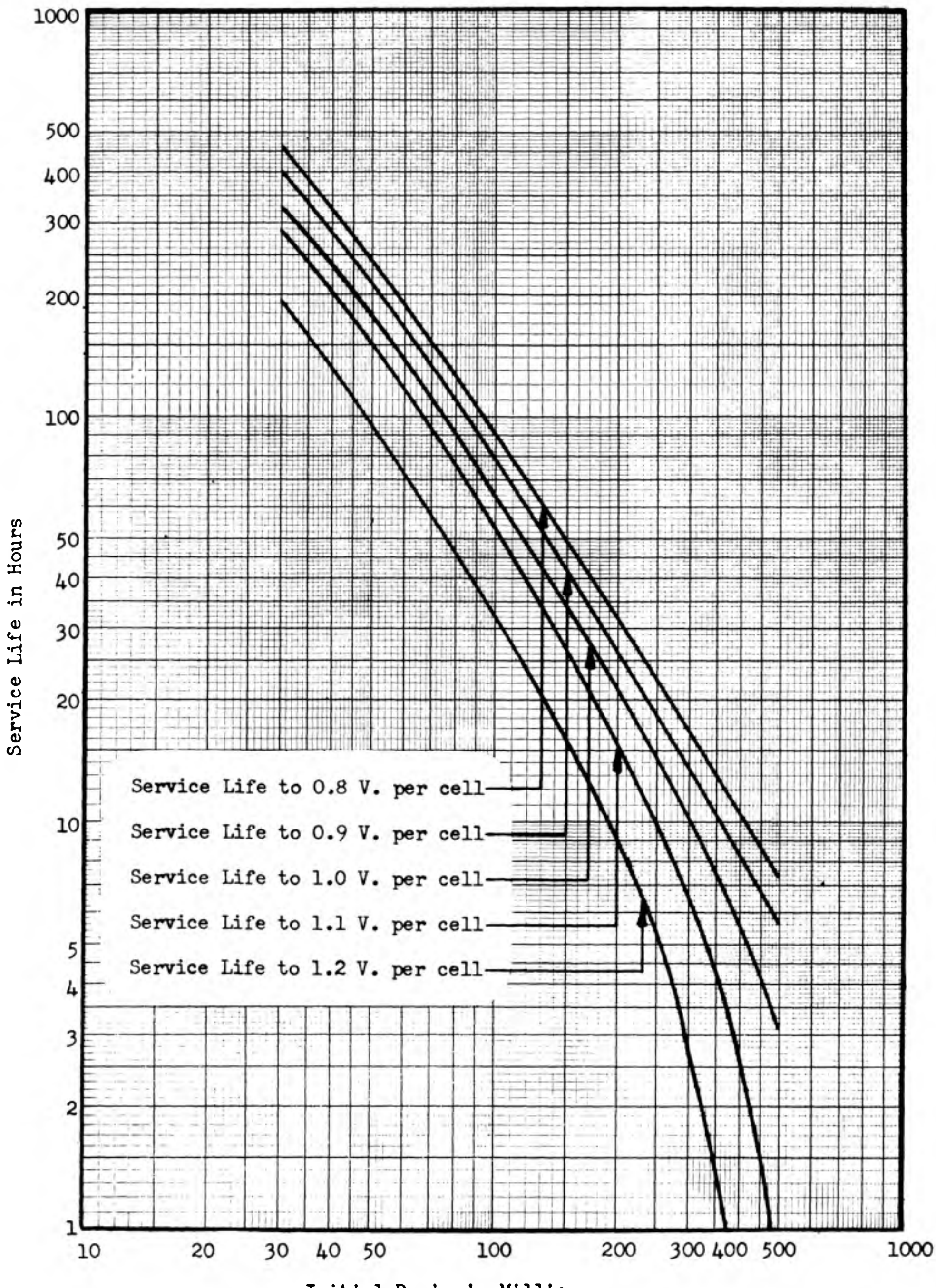


F-466

BURGESS **GRAPH NO. 52**

NUMBER 10 I CELLS
(ASA Cell Size F)

Service Life When
Discharged Continuously
At 70° F.



F-466

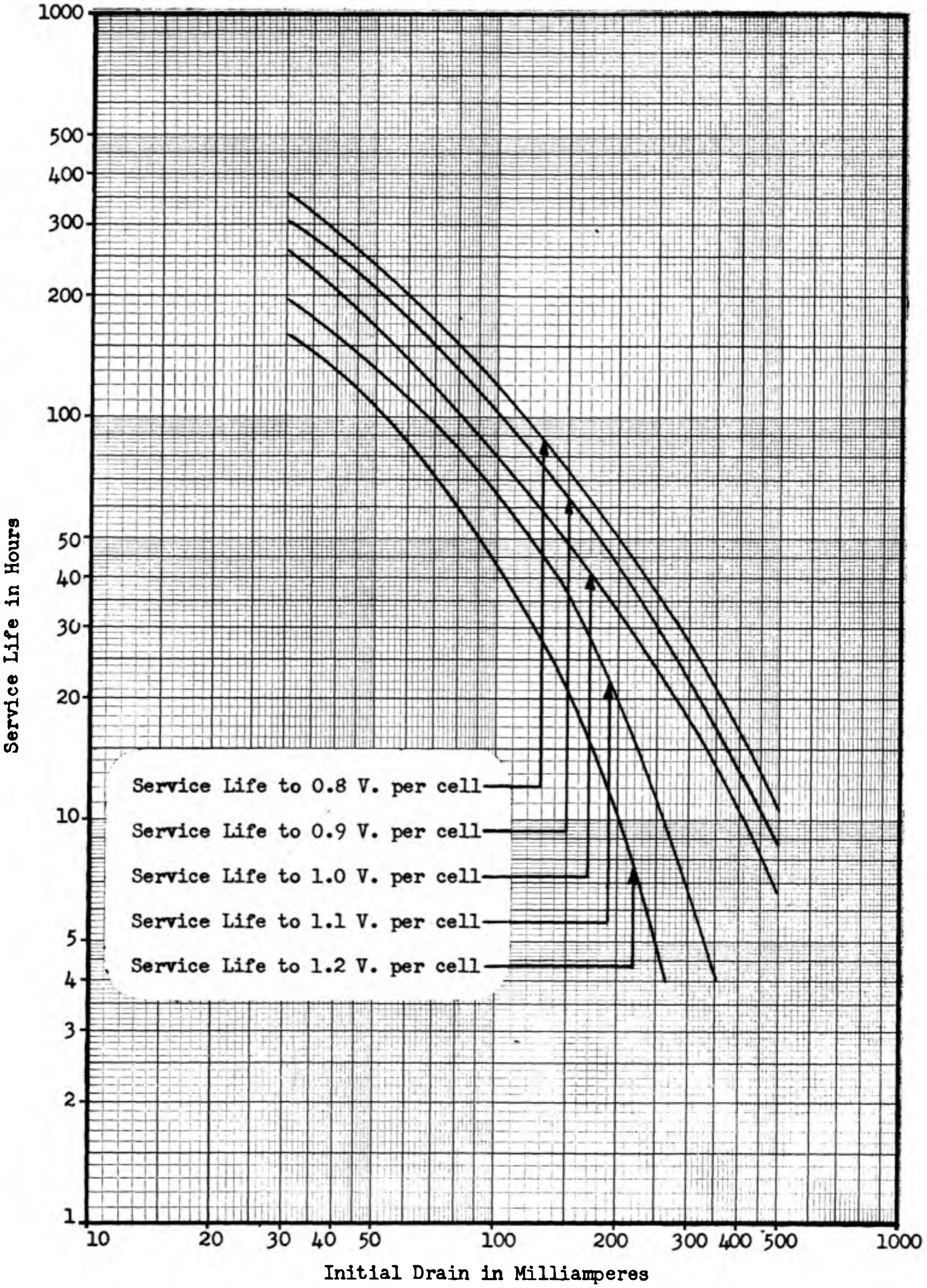
GRAPH NO.

53

BURGESS

NUMBER 10 I CELLS
(ASA Cell Size F)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



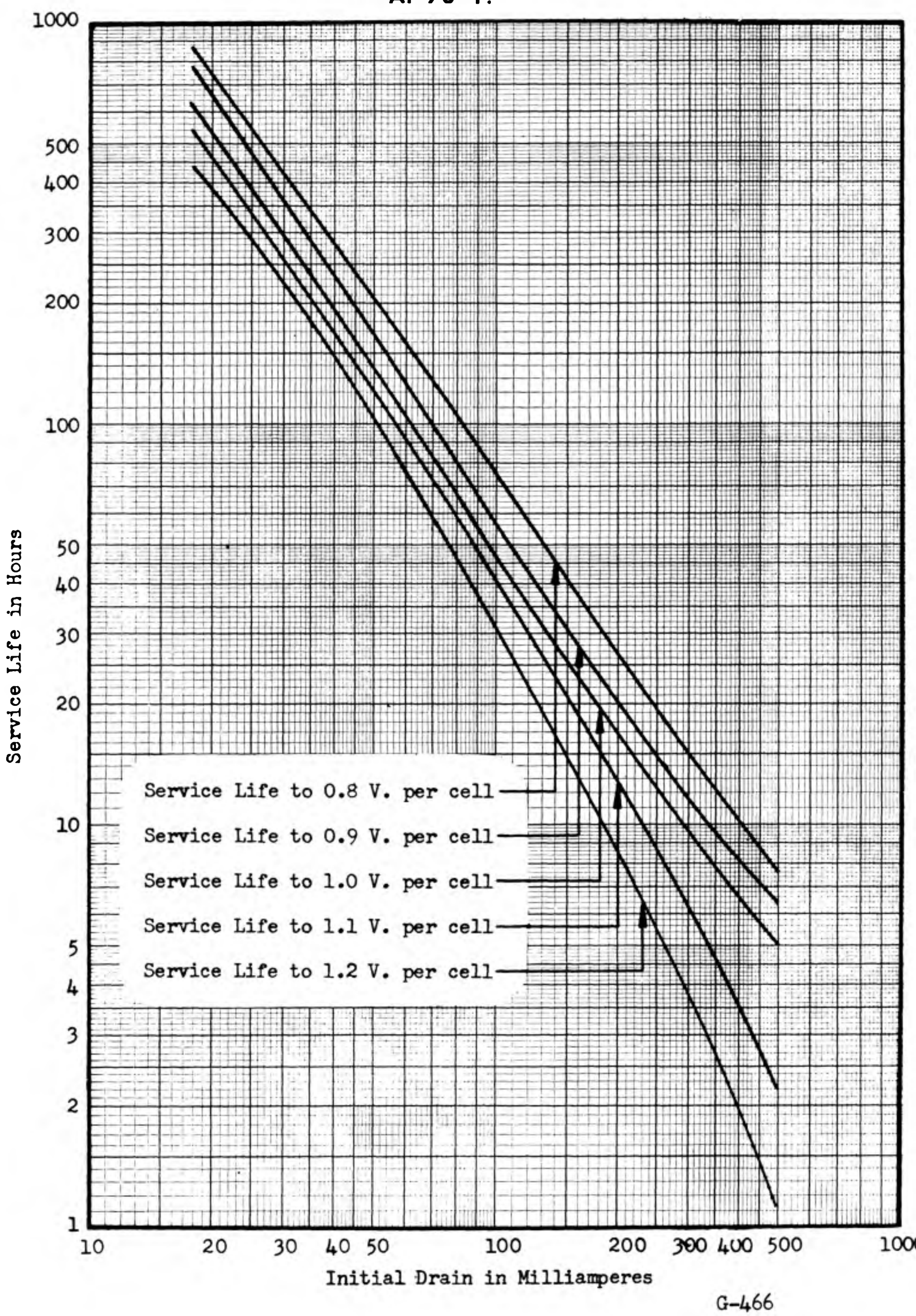
F-466

BURGESS

GRAPH NO. 54

NUMBER 21 CELLS
(ASA Cell Size G)

Service Life When Discharged Continuously At 70° F.



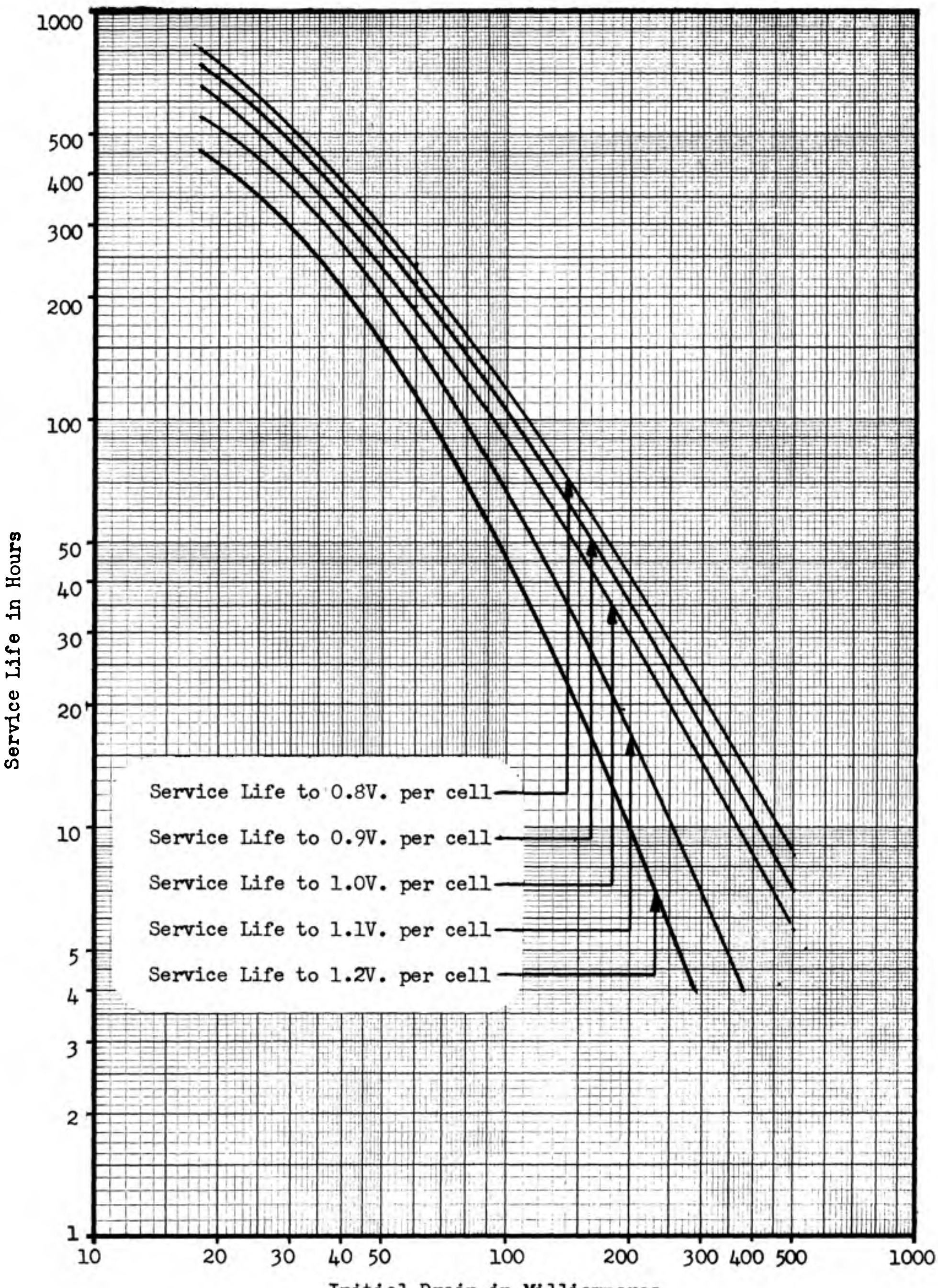
GRAPH NO.

55

BURGESS

NUMBER 21 CELLS
(ASA Cell Size G)

**Service Life When
Discharged 4 Hrs. Per Day
At 70° F.**



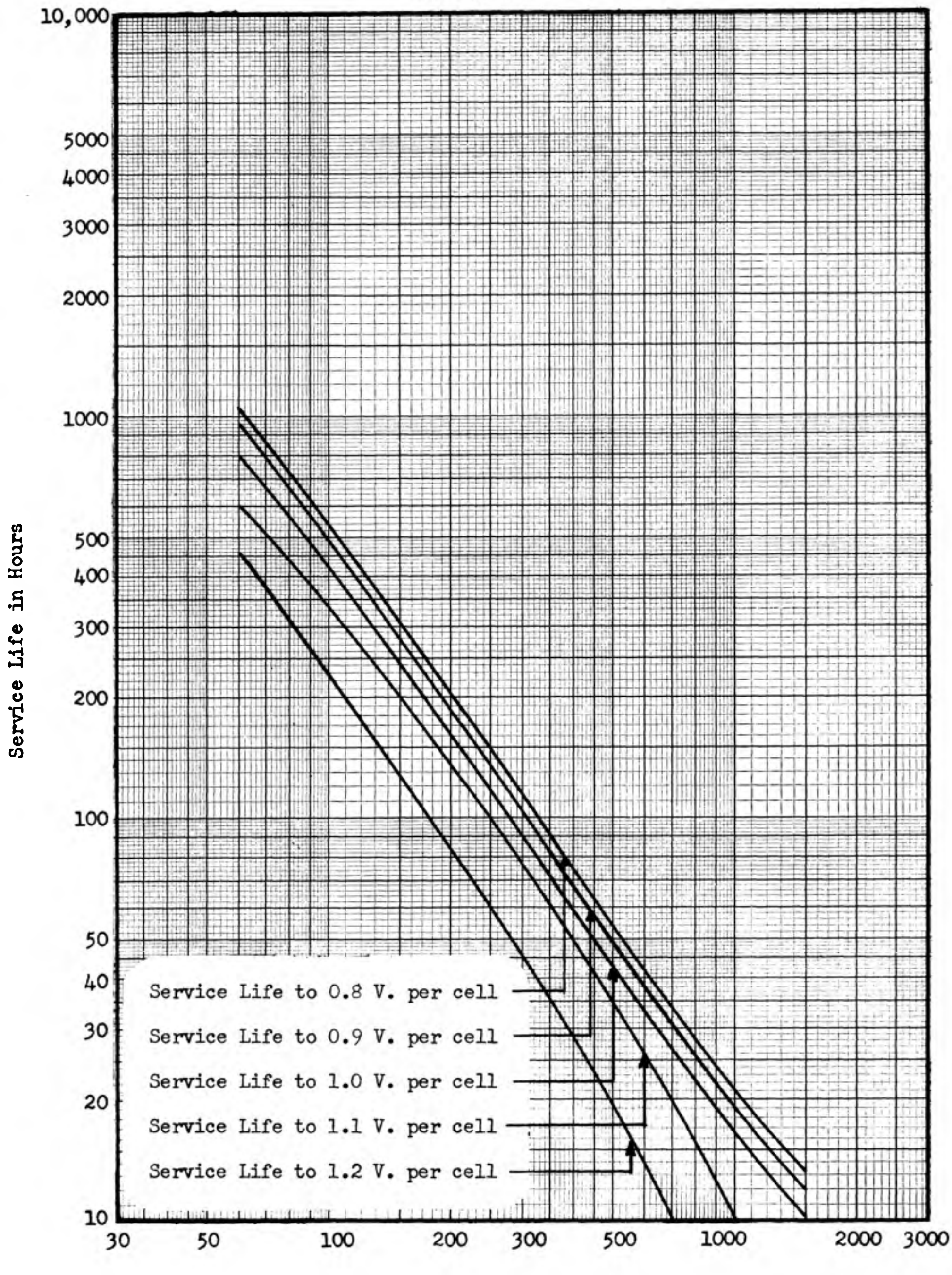
G-466

BURGESS

GRAPH NO. 56

NUMBER 6 IGNITION
(ASA Cell Size 6)

Service Life When Discharged Continuously At 70° F.



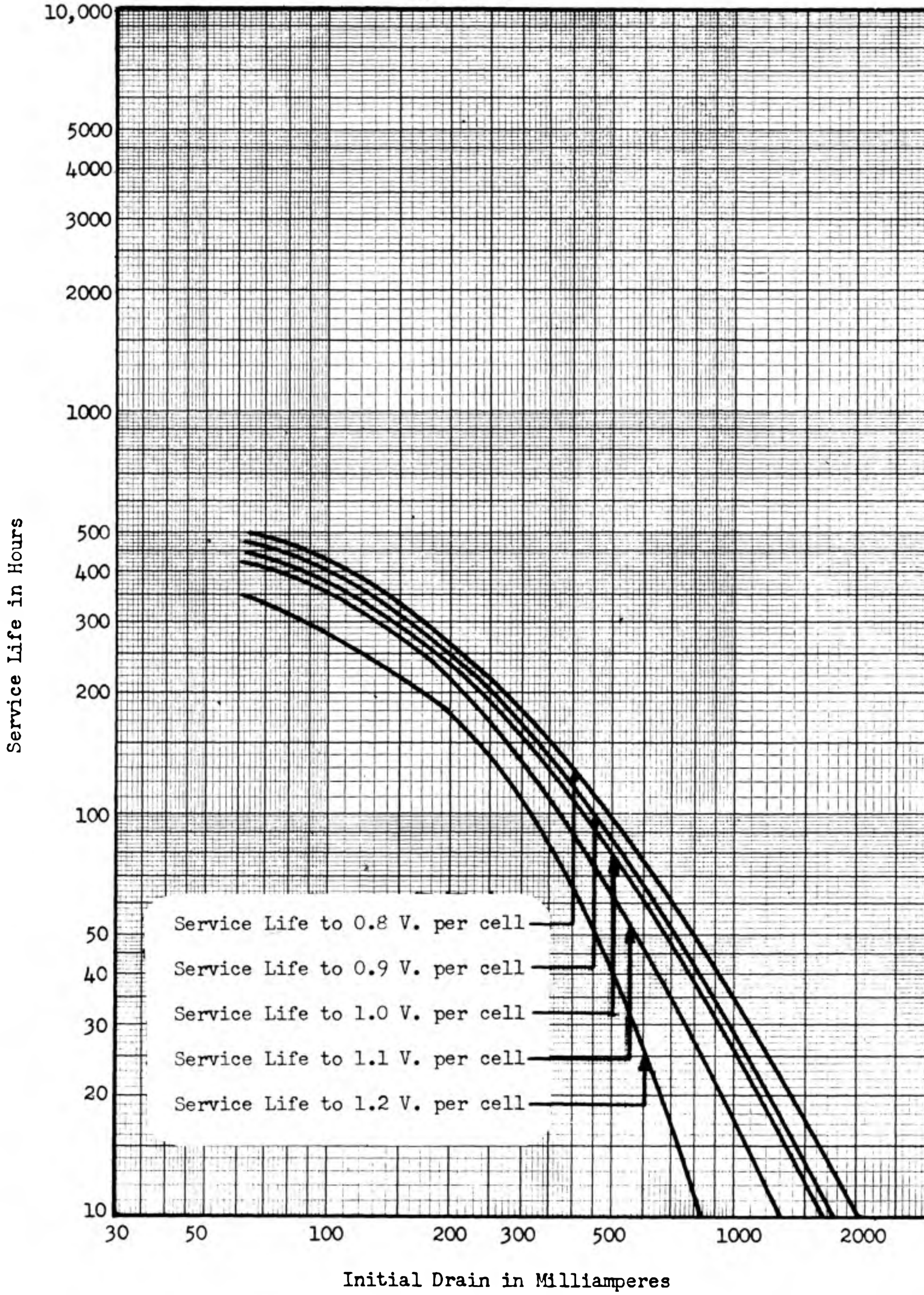
#6 Ign.-466

GRAPH NO. 57

BURGESS

NUMBER 6 IGNITION
(ASA Cell Size 6)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



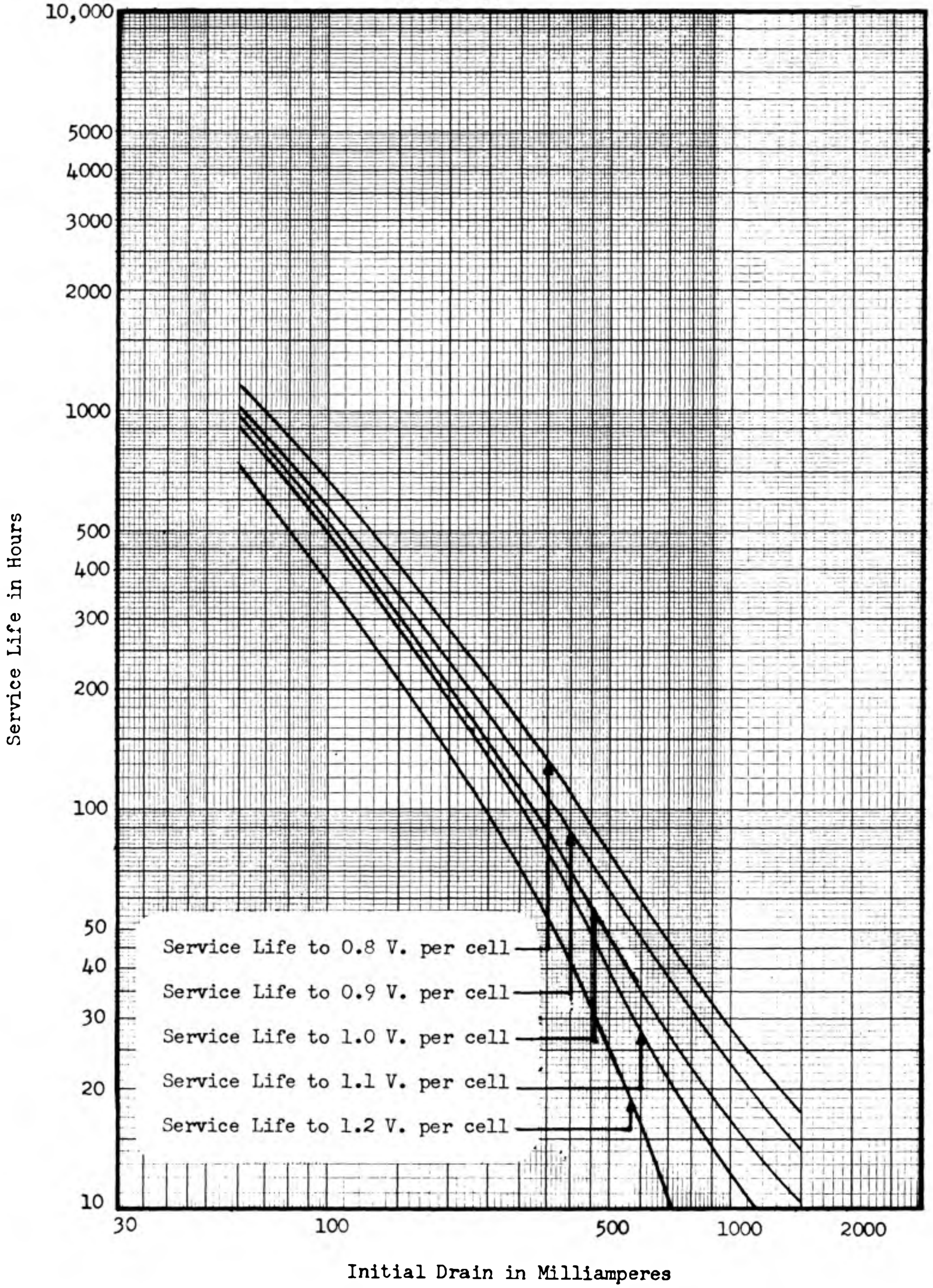
#6 Ign.-466

BURGESS

GRAPH NO. 58

NUMBER 6 R.R. & IND. (ASA Cell Size 6)

Service Life When Discharged Continuously At 70° F.



#6 R.R. & Ind.-466

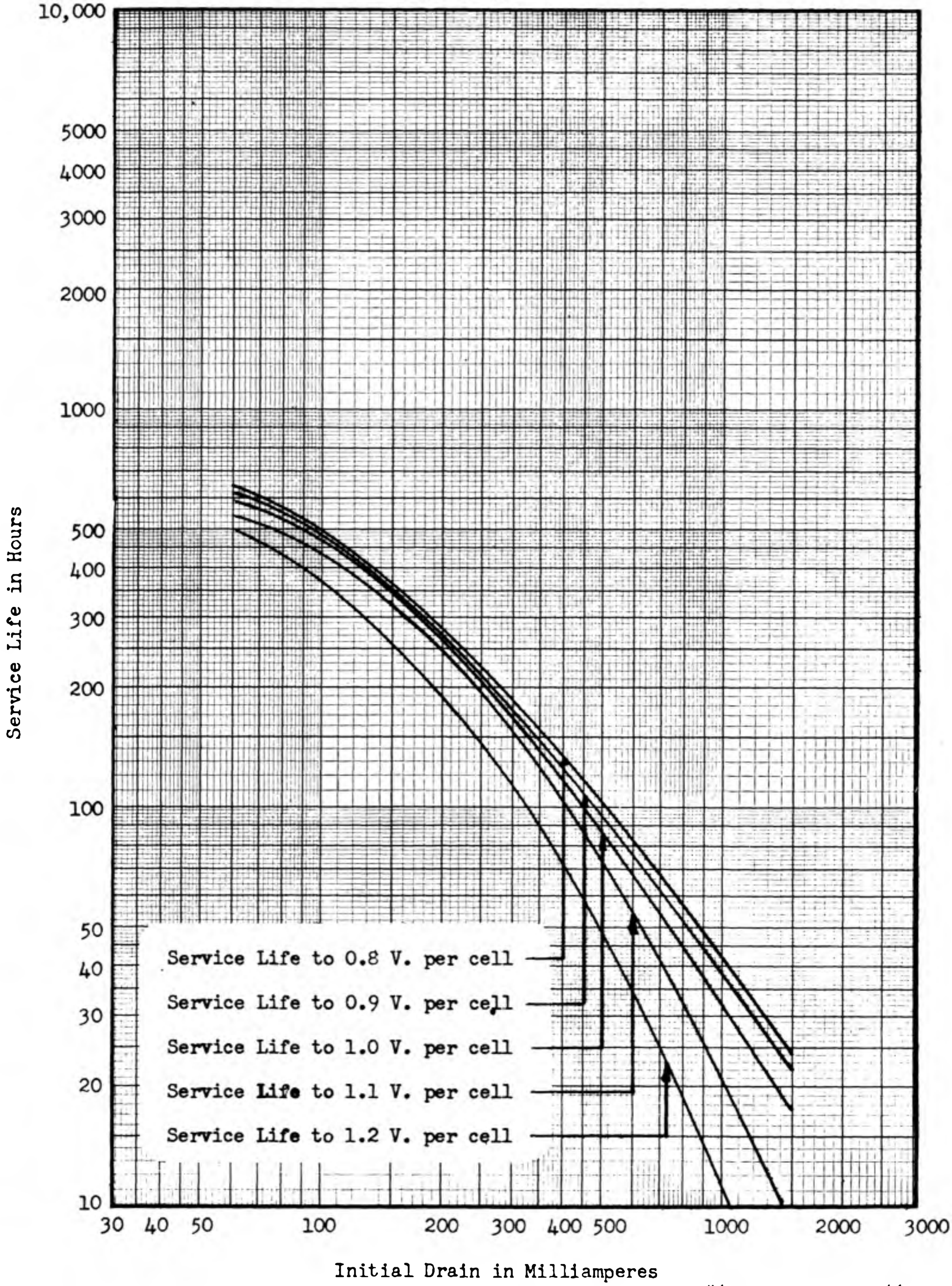
GRAPH NO.

59

BURGESS

NUMBER 6 R.R. & IND.
(ASA Cell Size 6)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



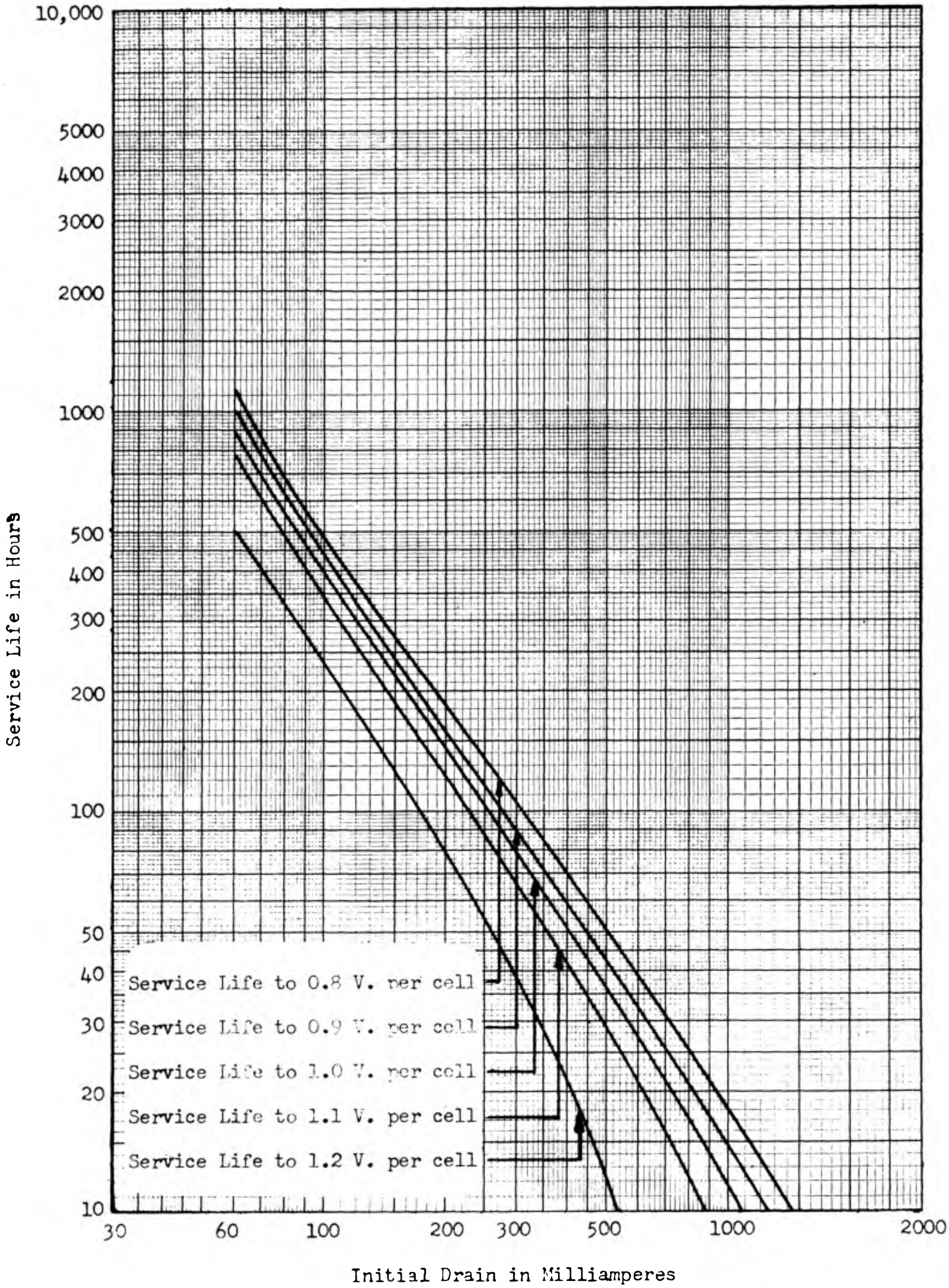
#6 R.R. & IND.-466

GRAPH NO. 60

BURGESS

NUMBER 6 TELEPHONE (ASA Cell Size 6)

Service Life When Discharged Continuously At 70° F.



#6 Tel.-466

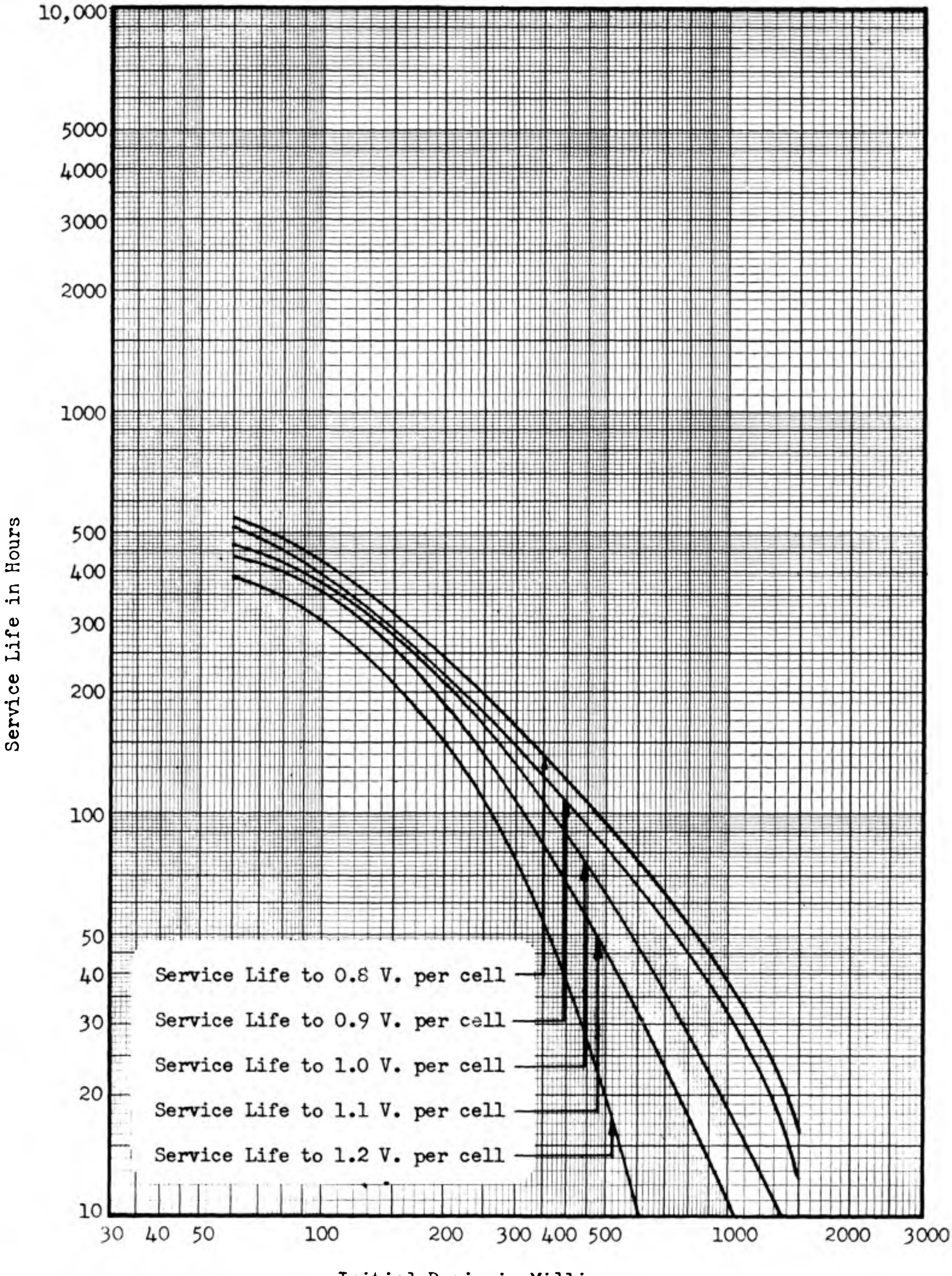
GRAPH NO.

61

BURGESS

NUMBER 6 TELEPHONE
(ASA Cell Size 6)

Service Life When Discharged 4 Hrs. Per Day At 70° F.



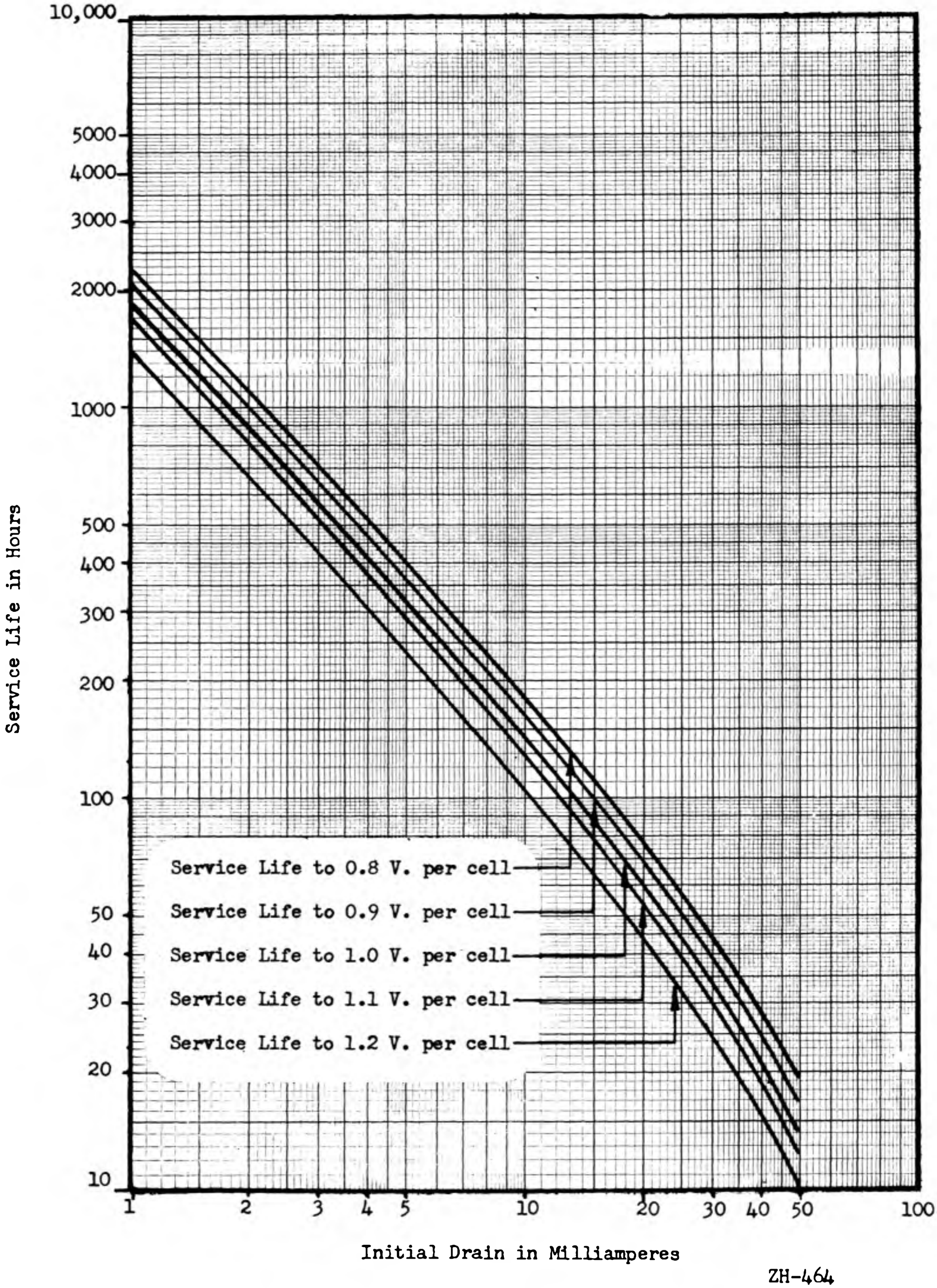
#6 Tel.-466

BURGESS

'ZH' CELLS

GRAPH NO. 62

Service Life When Discharged Continuously At 70° F.



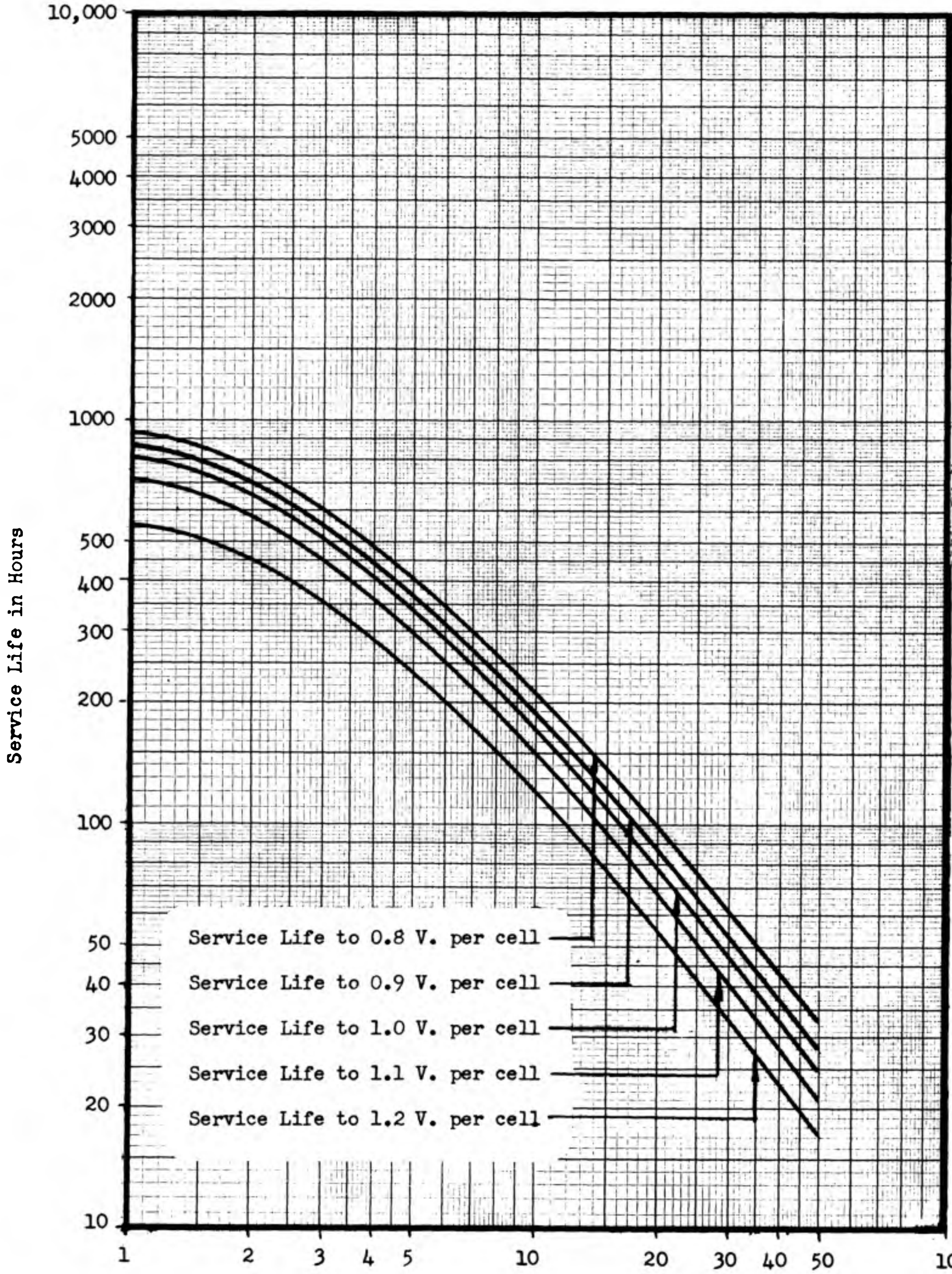
GRAPH NO.

63

BURGESS

'ZH' CELLS

Service Life When Discharged 4 Hrs. Per Day At 70° F.



ZH-464

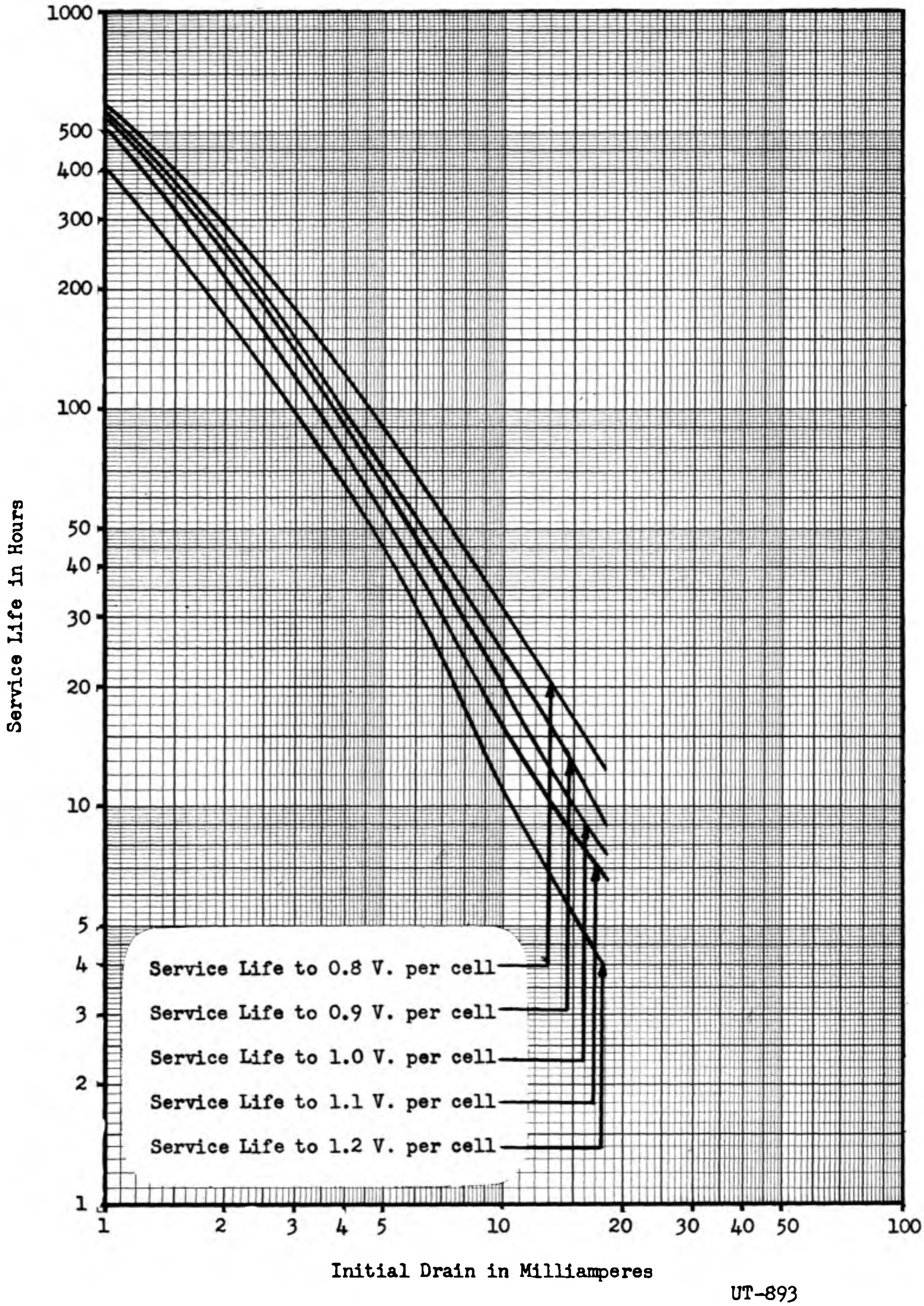
BURGESS

GRAPH NO.

64

"UT" CELLS

Service Life When
Discharged Continuously
At 70° F.



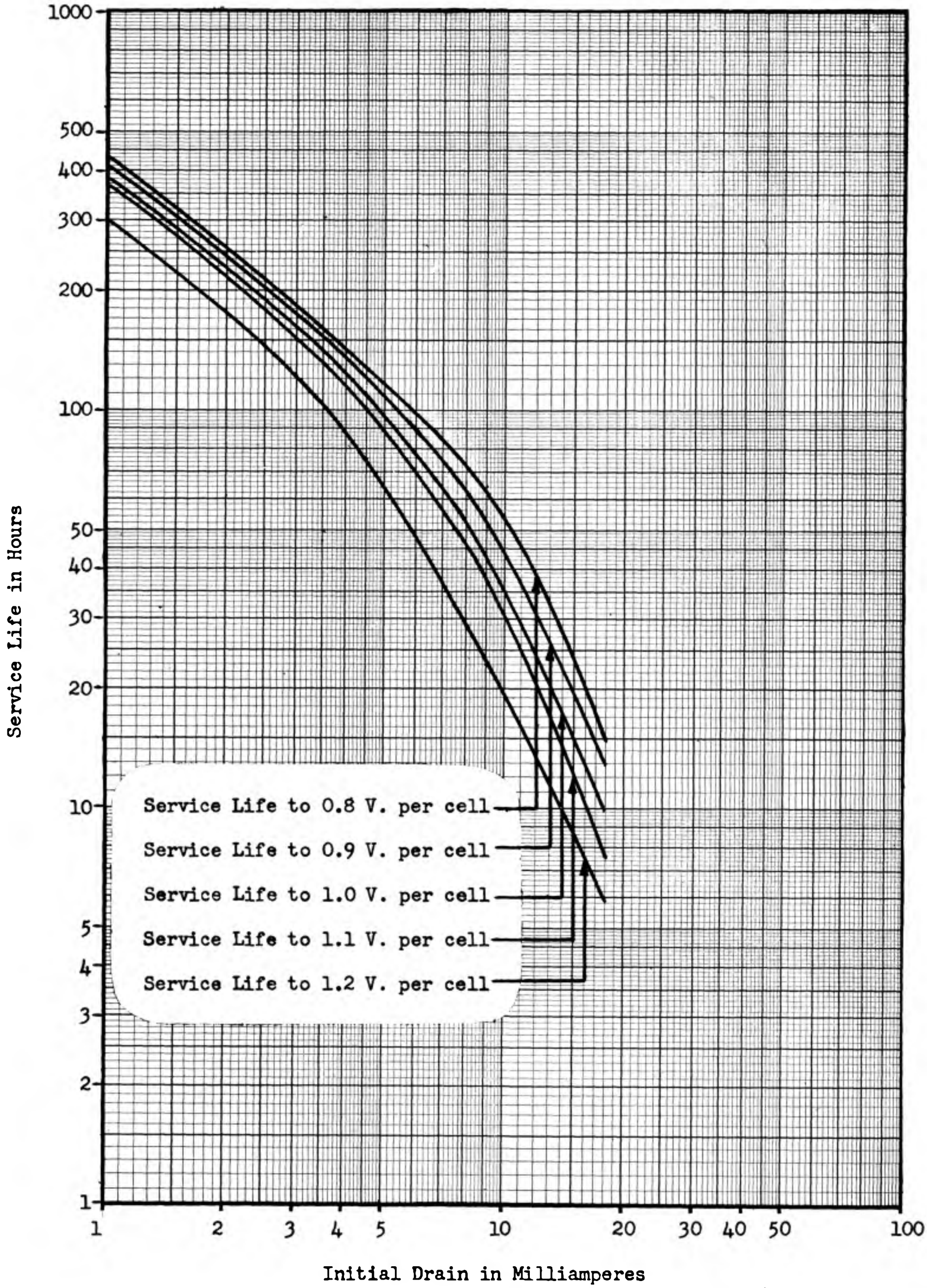
UT-893

GRAPH NO.
65

BURGESS

"UT" CELLS

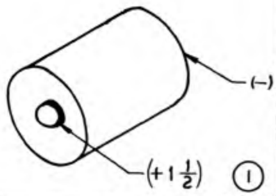
Service Life When Discharged 4 Hrs. Per Day At 70° F.



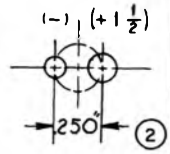
UT-893

TERMINAL ILLUSTRATIONS

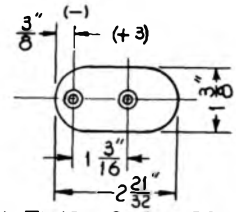
(Socket Type Terminals Are Shown As Viewed From Top)



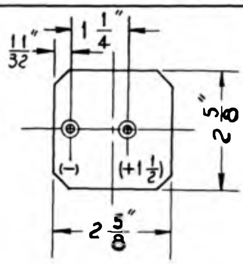
(1)



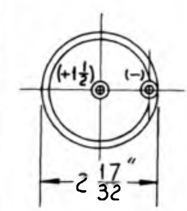
HOLES FOR ONE PIN 1/8" DIA. AND ONE PIN 5/32 DIA. (2)



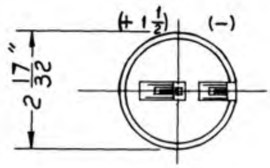
WITH TWO 8-32 BRASS NUTS. (3)



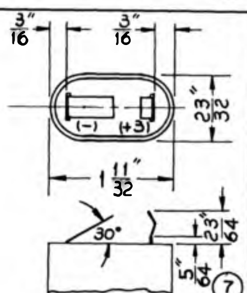
WITH TWO 8-32 BRASS NUTS. (4)



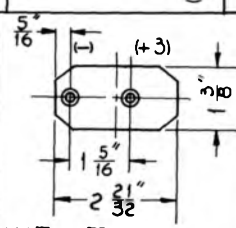
WITH TWO 8-32 BRASS NUTS. (5)



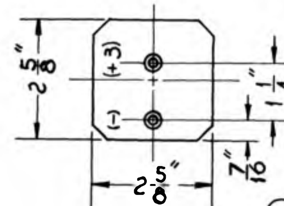
WITH TWO SPRING CLIPS. (6)



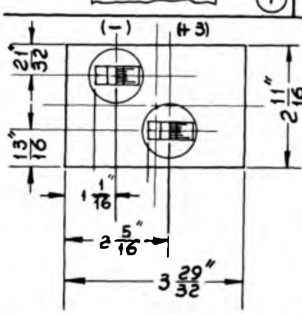
(7)



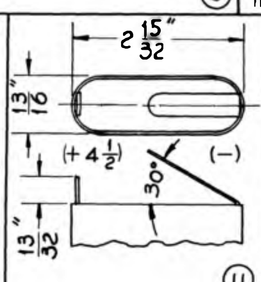
WITH TWO 8-32 INS. KNOBS. (8)



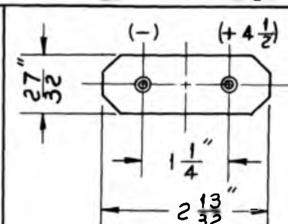
(9) WITH TWO 8-32 INSULATED KNOBS.



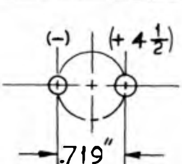
WITH TWO SPRING CLIPS. (10)



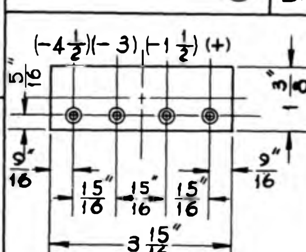
(11)



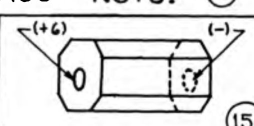
WITH TWO 8-32 BRASS NUTS. (12)



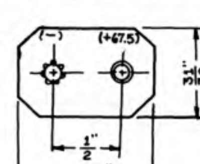
HOLES FOR ONE PIN 1/8" DIA AND ONE PIN 5/32" DIA. (13)



WITH FOUR 8-32 BRASS KNURLED NUTS. (14)



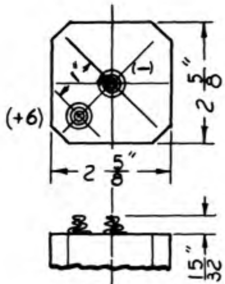
(15)



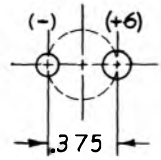
SNAP TERMINALS: UNITED CARR CO. PART No. NEGATIVE-52784 POSITIVE-52719 (15A)

TERMINAL ILLUSTRATIONS

(Socket Type Terminals Are Shown As Viewed From Top)

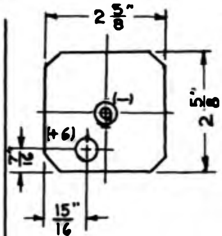


(16)



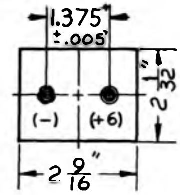
HOLES FOR
1 PIN 1/8" DIA.
1 PIN 5/32" DIA.

(17)



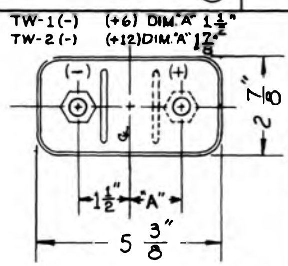
WITH TWO
8-32 BRASS
NUTS.

(18)



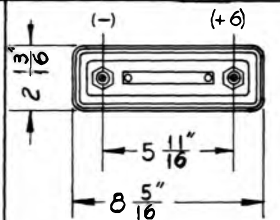
SNAP TERMINALS:
UNITED-CARR
PART NO.
12209 NEGATIVE
12302 POSITIVE

(19)



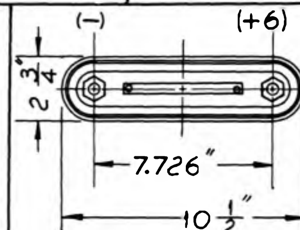
WITH TWO 8-32
INSULATED KNOBS.

(20)



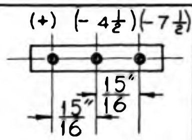
WITH TWO 8-32
INSULATED KNOBS
& HANDLE STRAP.

(21)



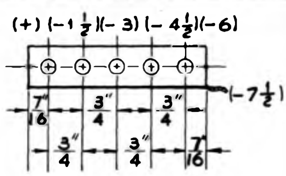
WITH TWO 8-32
INSULATED KNOBS
& HANDLE STRAP.

(22)



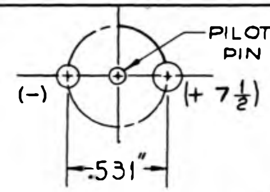
WITH THREE
8-32 BRASS
NUTS.

(23)



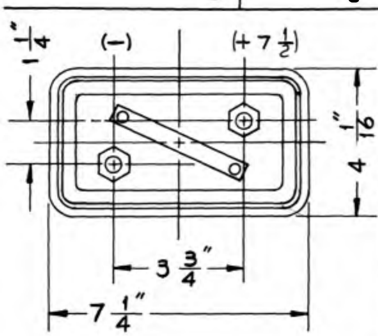
WITH FIVE 8-32
BRASS NUTS &
ONE 4 1/2" INS. LEAD.

(24)



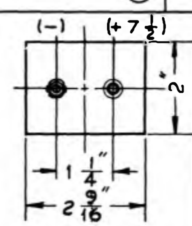
HOLES FOR - ONE PIN 1/8" DIA,
ONE PIN 3/32" DIA. (PILOT)
ONE PIN 5/32" DIA.

(25)



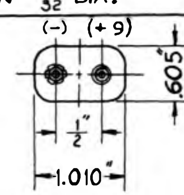
WITH TWO 8-32 INSULATED
KNOBS & HANDLE STRAP.

(26)



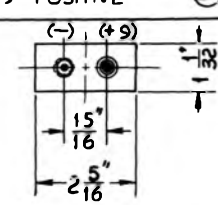
SNAP TERMINALS:
UNITED-CARR FASTENER PART NO.
12209 - NEGATIVE
12302 - POSITIVE

(27)



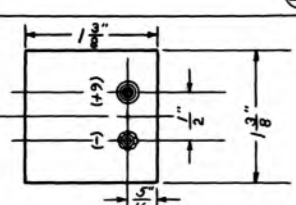
SNAP TERMINALS:
UNITED CARR PART NO.
52784 NEGATIVE
52719 POSITIVE

(28)



SNAP TERMINALS:
UNITED CARR PART NO.
12209 NEGATIVE
12302 POSITIVE

(30)

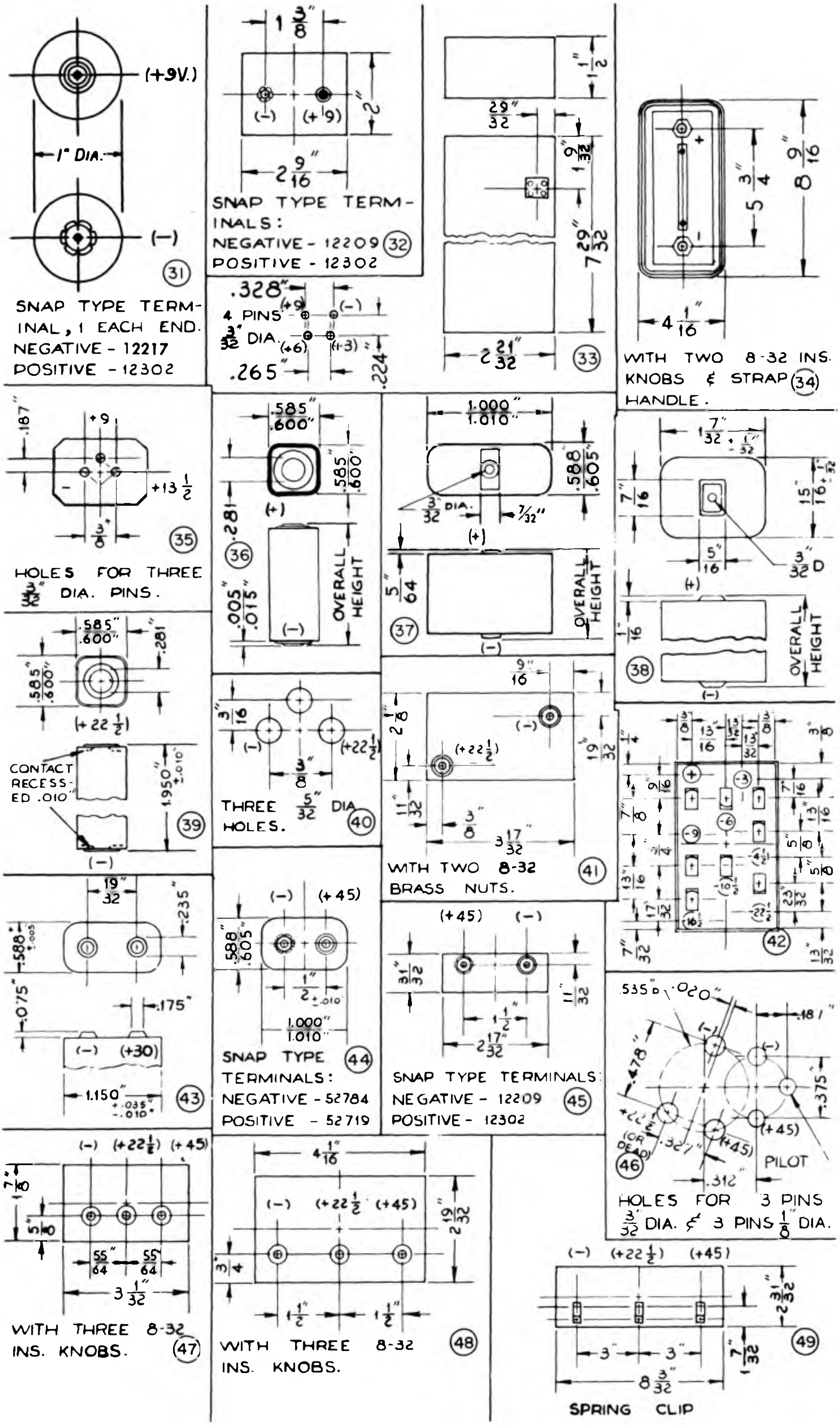


SNAP TERMINALS:
UNITED CARR
PART NO.
52784 NEGATIVE
52719 POSITIVE

(29)

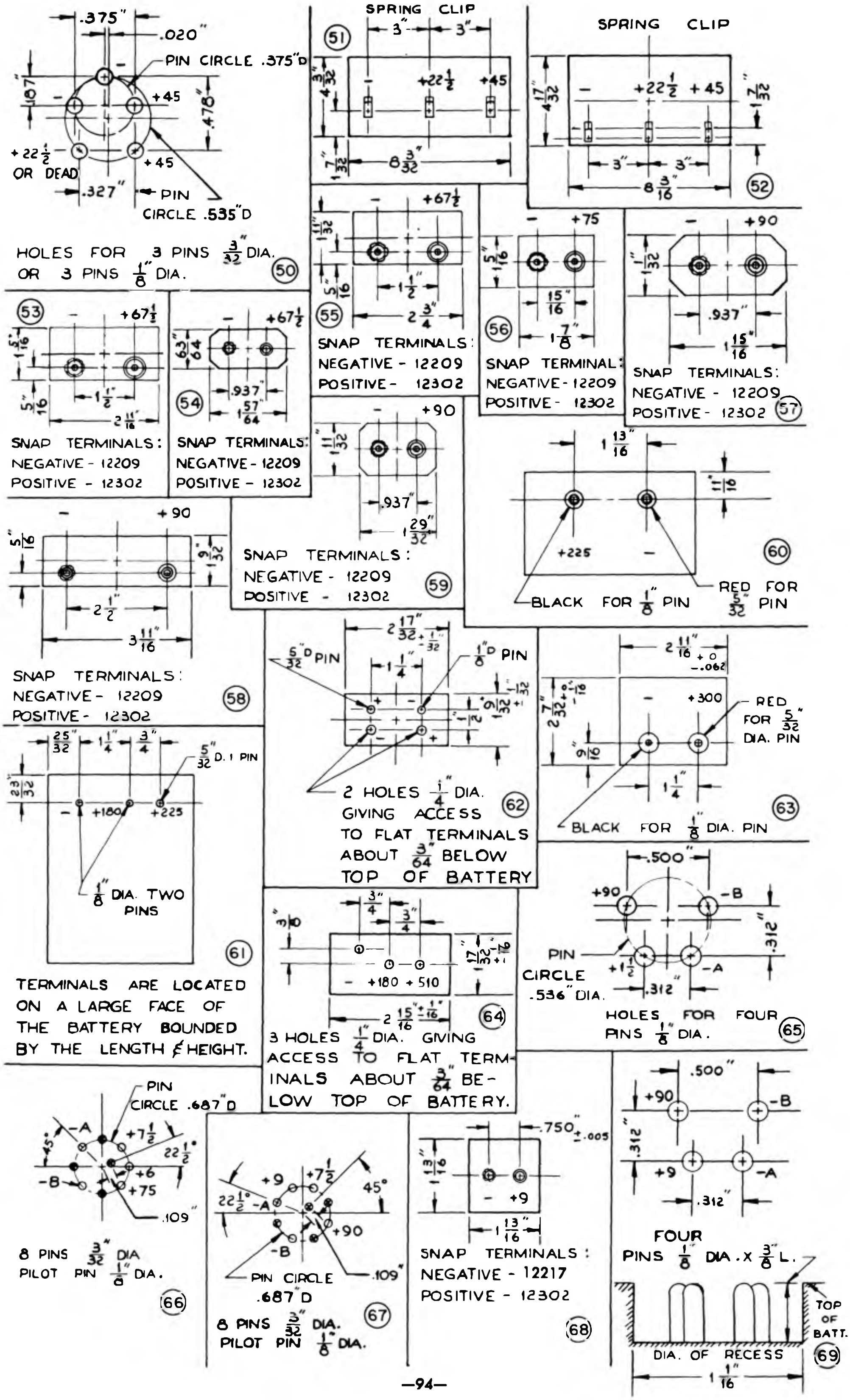
TERMINAL ILLUSTRATIONS

(Socket Type Terminals Are Shown As Viewed From Top)



TERMINAL ILLUSTRATIONS

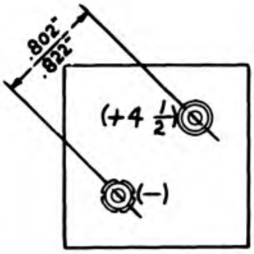
(Socket Type Terminals Are Shown As Viewed From Top)



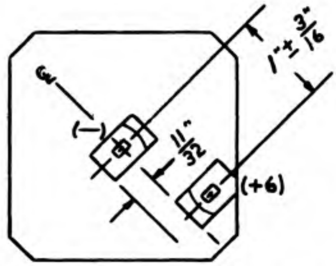
TERMINAL ILLUSTRATIONS

(Socket Type Terminals Are Shown As Viewed From Top)

(70)

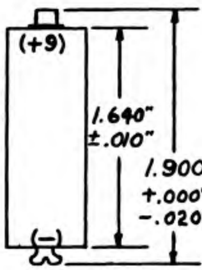


SNAP TYPE TERMINALS:
UNITED CARR PART NO.
NEGATIVE — 52784
POSITIVE — SS52903

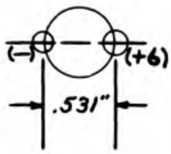


WITH TWO SPRING CLIPS (71)

(72)



SNAP TYPE TERMINALS:
UNITED CARR PART NO.
NEGATIVE — 52784
POSITIVE — SS52903



(73)

HOLES FOR 1 PIN 1/8" DIA.
1 PIN 5/32" DIA.
ASA SOCKET NO. VI

BURGESS MERCURY BATTERIES

COMPONENTS AND GENERAL CHARACTERISTICS

Burgess mercury cells consist of a positive electrode of mecuric oxide mixed with conductive material and a negative electrode of finely divided zinc. The electrolyte is a caustic solution which is immobilized in the cell. Both the positive and negative electrodes are pressed into proper shape before assembly into sealed steel cans which have provisions for self-venting.

Mercury cells are made in two different designs:

(a) Flat type — Electrodes are pressed into flat circular shapes such as characterized by Hg-625R or Hg-3R.

(b) Cylindrical type — Electrodes are pressed into hollow cylindrical shapes such as characterized by Hg-9 or Hg-42R.

Burgess Mercury cells are especially suited to provide maximum power output in minimum space. Their flat discharge curve makes them an ideal source of power where voltage regulation is an important consideration. They provide the following desirable operating characteristics.

(1) High ratio of energy to volume and weight.
(2) Long shelf life.
(3) No need for recovery periods during discharge.
(4) Relatively constant potential during discharge.

TEMPERATURE CHARACTERISTICS

Mercury batteries are suitable for use at temperatures above normal room temperature, ranging up to about 130°F. The nature of their electrochemical system does not make them as well suited for operation at lower temperatures. Severe capacity loss results at about 40°F. and near 32°F. they will give very little service except on light drains.

Mercury batteries that have been exposed to low temperatures will again give normal service after being allowed to warm to room temperature of about 70°F.

The following tabulation shows the service that may be expected at various temperatures, with service at 70°F. expressed as 100%.

Discharge Temperature	Approximate Service Expressed as Percent of Service at 70° F.	
	Light Drain (1)	Heavy Drain (2)
113° F.	100%	100%
70° F.	100%	100%
40° F.	95%	7%
28° F.	6%	2%

(1) A light drain may be defined as a drain which will result in 100 hours or more service on a given cell.

(2) A Heavy drain may be defined as a drain which will result in 30 hours or less on a given cell.

CELL VOLTAGE AND RATED CAPACITY

Mercury cells commonly employ two different types of depolarizers. In general, cells having numbers followed by the letter "R" have an open circuit voltage of obout 1.35 volts. They are recommended for use in applications where higher than normal temperatures may be encountered or where cells are to be used as voltage reference sources.

Cells using the other type depolarizer have no letter following the number and have an open circuit voltage of about 1.40 volts.

Capacity is normally expressed in milliampere hours. Optimum cell efficiency is obtained at a current drain of 0.1 ampere per square inch of depolarizer surface. Recommended drains are given for each cell which will result in optimum efficiency.

IMPEDANCE

The internal impedance of Mercury cells during discharge is low and substantially constant over 80% of the voltage range from 1.35 to 0.9 volts. Typical impedance data at 1000 cycles and 70° F. are as follows:

Cell Size	Type Electrode	Current Range in Milliamperes	Impedance (Ohms)
Hg-520	Flat Circular	1-10	8-9
Hg-625R	Flat Circular	1-20	2-4
Hg-400R	Flat Circular	1-10	3.25-4.75
Hg-502R	Cylindrical	1-200	0.35-0.45

BURGESS Mercury Activator Cells

No. Hg-312

No. Hg-400R

No. Hg-520

No. Hg-675

No. Hg-625R

No. Hg-450R

No. Hg-630

No. Hg-640

No. Hg-401

No. Hg-1R

No. Hg-601R

No. Hg-3R

No. Hg-502R

No. Hg-9

No. Hg-4R

No. Hg-12R

No. Hg-42R

PHYSICAL DESCRIPTION

Battery No. (In order of Increasing Size)	CELLS USED		Voltage Taps	Rated Capacity		Maximum Dimensions Inches		Vol. Cu. In.	Wt. in Lbs.	Type Terminals	SERVICE LIFE		
	No.	Size		MAH	at Drain of	Dia.	Over-all Height				Mercury Graph No.	Divide Drain of Using Equip. By	Battery Voltage Equals Volts Per Cell Times
Hg-312	1	Hg-312	—, +1.40	36	2 Ma.	0.310	0.140	0.01	0.0013	Flat	1	1	1
Hg-400R	1	Hg-400R	—, +1.35	75	2 Ma.	0.455	0.135	0.02	0.0025	Flat	2	1	1
Hg-520	1	Hg-520	—, +1.40	130	5 Ma.	0.495	0.286	0.05	0.0044	Flat	3	1	1
Hg-675	1	Hg-675	—, +1.40	160	5 Ma.	0.455	0.210	0.03	0.0056	Flat	4	1	1
Hg-625R	1	Hg-625R	—, +1.35	250	5 Ma.	0.615	0.238	0.07	0.0094	Flat	5	1	1
Hg-450R	1	Hg-450R	—, +1.35	350	3 Ma.	0.455	0.570	0.09	0.0110	Flat	6	1	1
Hg-630	1	Hg-630	—, +1.40	350	5 Ma.	0.615	0.238	0.07	0.0110	Flat	7	1	1
Hg-640	1	Hg-640	—, +1.40	500	10 Ma.	0.625	0.440	0.13	0.0163	Flat	8	1	1
Hg-401	1	Hg-401	—, +1.40	800	25 Ma.	0.460	1.130	0.18	0.0250	Flat	9	1	1
Hg-1R	1	Hg-1R	—, +1.35	1000	35 Ma.	0.625	0.650	0.20	0.0270	Flat	10	1	1
Hg-601R	1	Hg-601R	—, +1.35	1800	30 Ma.	0.632	1.140	0.33	0.0760	Flat	11	1	1
Hg-3R	1	Hg-3R	—, +1.35	2200	42 Ma.	0.985	0.660	0.50	0.0580	Flat	12	1	1
Hg-502R	1	Hg-502R	—, +1.35	2400	50 Ma.	0.545	1.968	0.44	0.0650	Flat	13	1	1
Hg-9	1	Hg-9	—, +1.40	2400	50 Ma.	0.545	1.968	0.44	0.0650	Flat	14	1	1
Hg-4R	1	Hg-4R	—, +1.35	3400	63 Ma.	1.195	0.660	0.74	0.1000	Flat	15	1	1
Hg-12R	1	Hg-12R	—, +1.35	3600	62 Ma.	0.637	1.968	0.60	0.0880	Flat	16	1	1
Hg-42R	1	Hg-42R	—, +1.35	14000	250 Ma.	1.230	2.390	2.90	0.3650	Flat	17	1	1

BURGESS Mercury Activator Batteries

No. H177

No. H146

No. H163

No. H164

No. H165

No. H133

No. H233

PHYSICAL DESCRIPTION

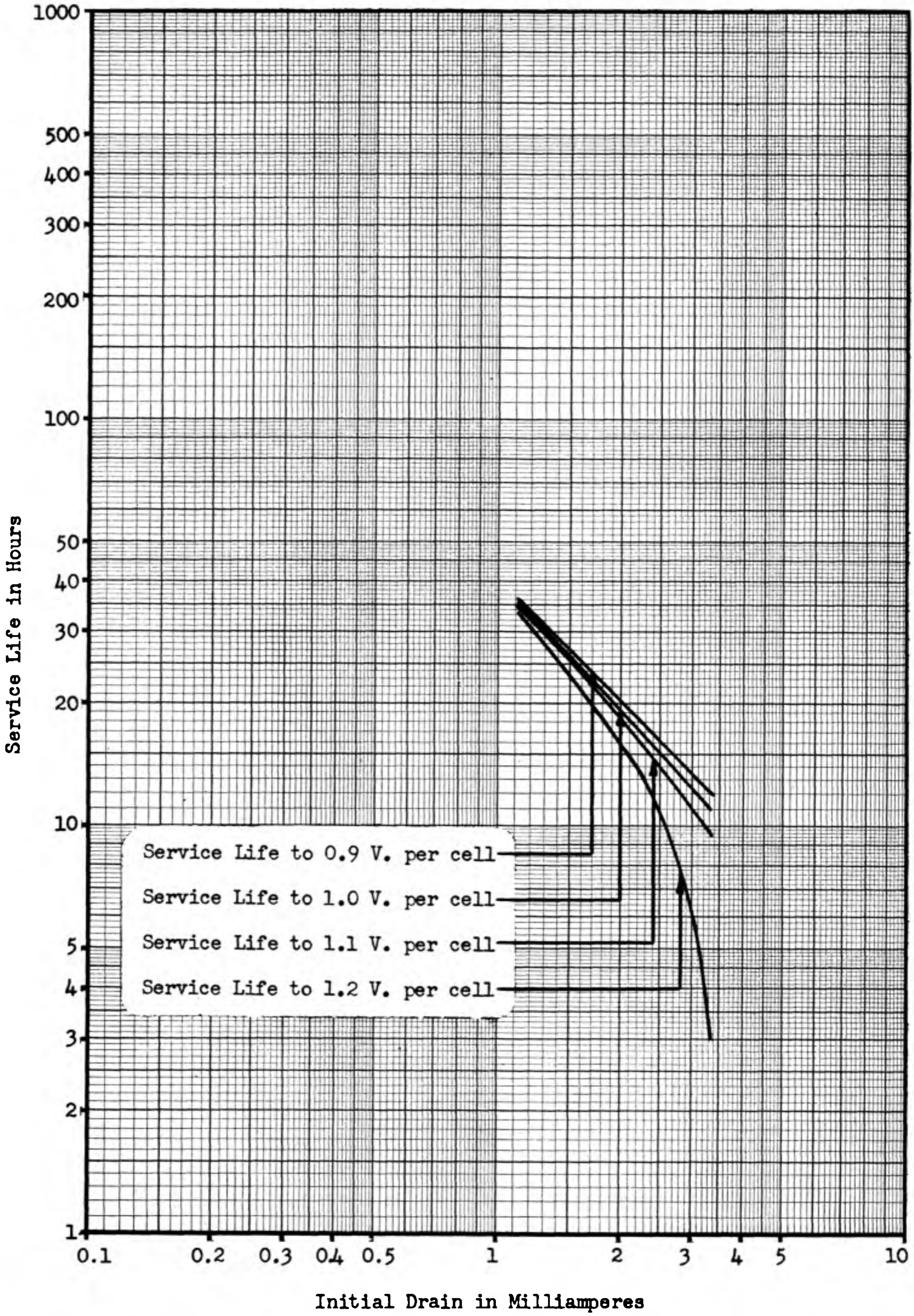
Battery No. (In order of Increasing Size)	CELLS USED		Voltage Taps	Rated Capacity		Maximum Dimensions Inches		Vol. Cu. In.	Wt. in Lbs.	Type Terminals	SERVICE LIFE		
	No.	Size		MAH	at Drain of	Dia.	Over-all Height				Mercury Graph No.	Divide Drain of Using Equip. By	Battery Voltage Equals Volts Per Cell Times
H177	7	Hg-675	—, +9.8	160	5 Ma.	0.555	1.906	0.46	0.062	Small Snap	4	1	7
H146	6	Hg-450	—, +8.4	350	3 Ma.	1x.625x2		0.90	0.100	Small* Snap	6	1	6
H163	3	Hg-640	—, +4.2	500	10 Ma.	0.662	1.327	0.44	0.055	Flat	8	1	3
H164	4	Hg-640	—, +5.6	500	10 Ma.	0.662	1.767	0.58	0.073	Flat	8	1	4
H165	5	Hg-640	—, +7.0	500	10 Ma.	0.662	2.217	0.73	0.091	Flat	8	1	5
H133	3	Hg-1	—, +4.2	1000	35 Ma.	0.662	1.965	0.65	0.088	Flat	10	1	3
H233	3	Hg-3	—, +4.2	2200	42 Ma.	1.016	1.967	1.60	0.188	Flat	12	1	3

* Terminal sketch No. 28

MERCURY
GRAPH NO.
1

BURGESS
Hg-312 CELLS

Service Life When Discharged Continuously At 70°



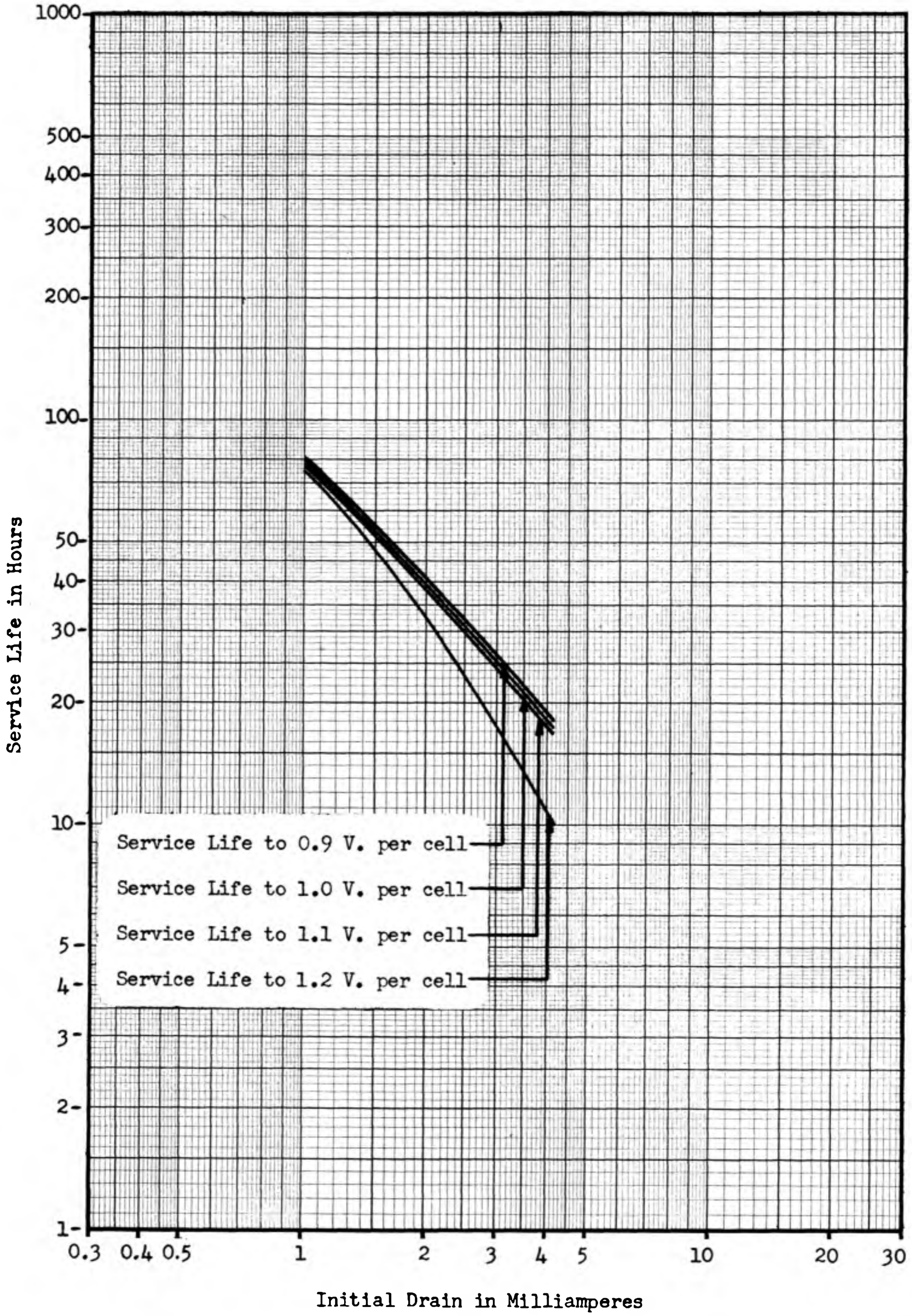
Hg-312 - 902

BURGESS

Hg-400R CELLS

MERCURY GRAPH NO. 2

Service Life When Discharged Continuously At 70°



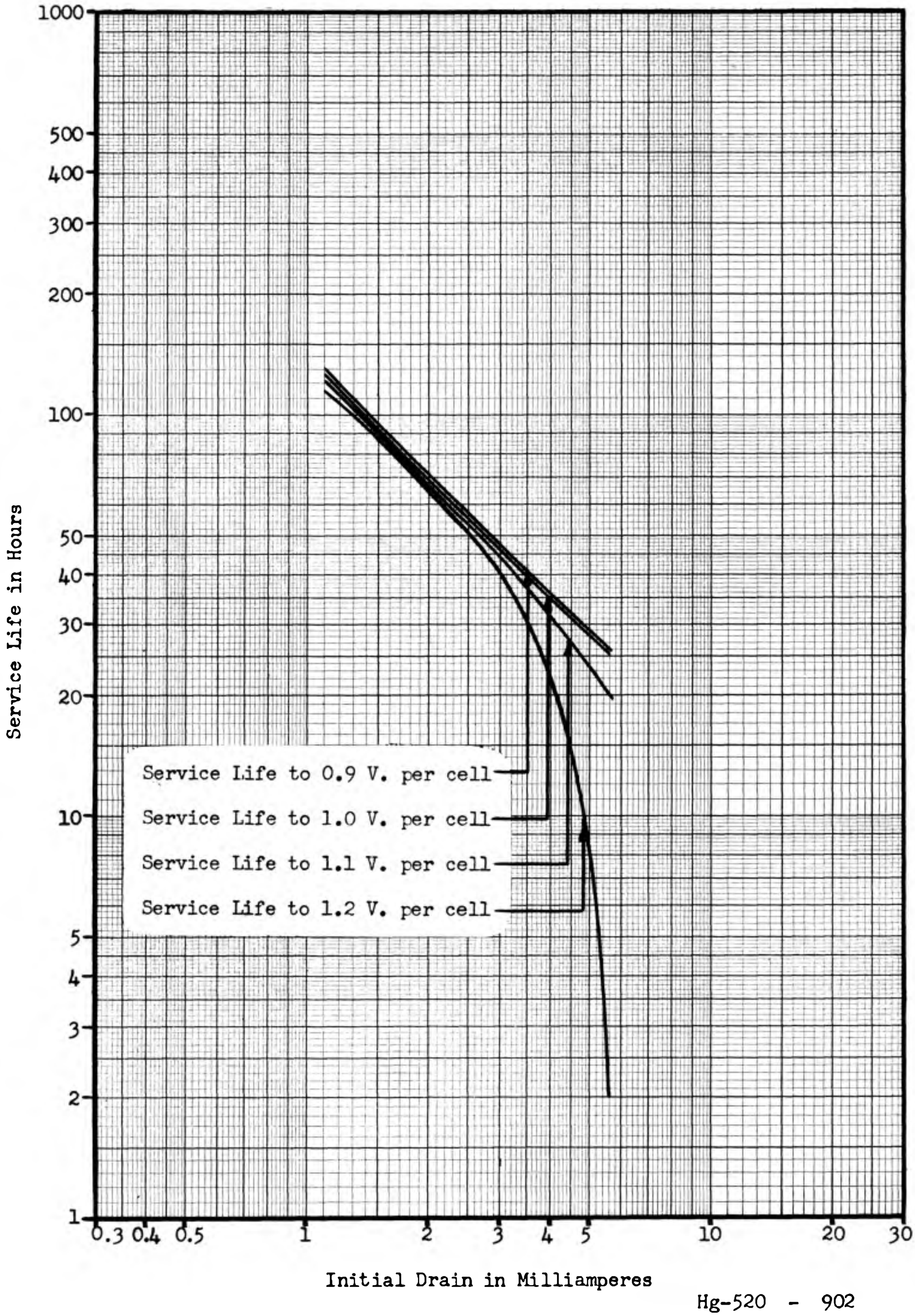
Hg-400R - 902

MERCURY GRAPH NO. 3

BURGESS

Hg-520 CELLS

Service Life When Discharged Continuously At 70°



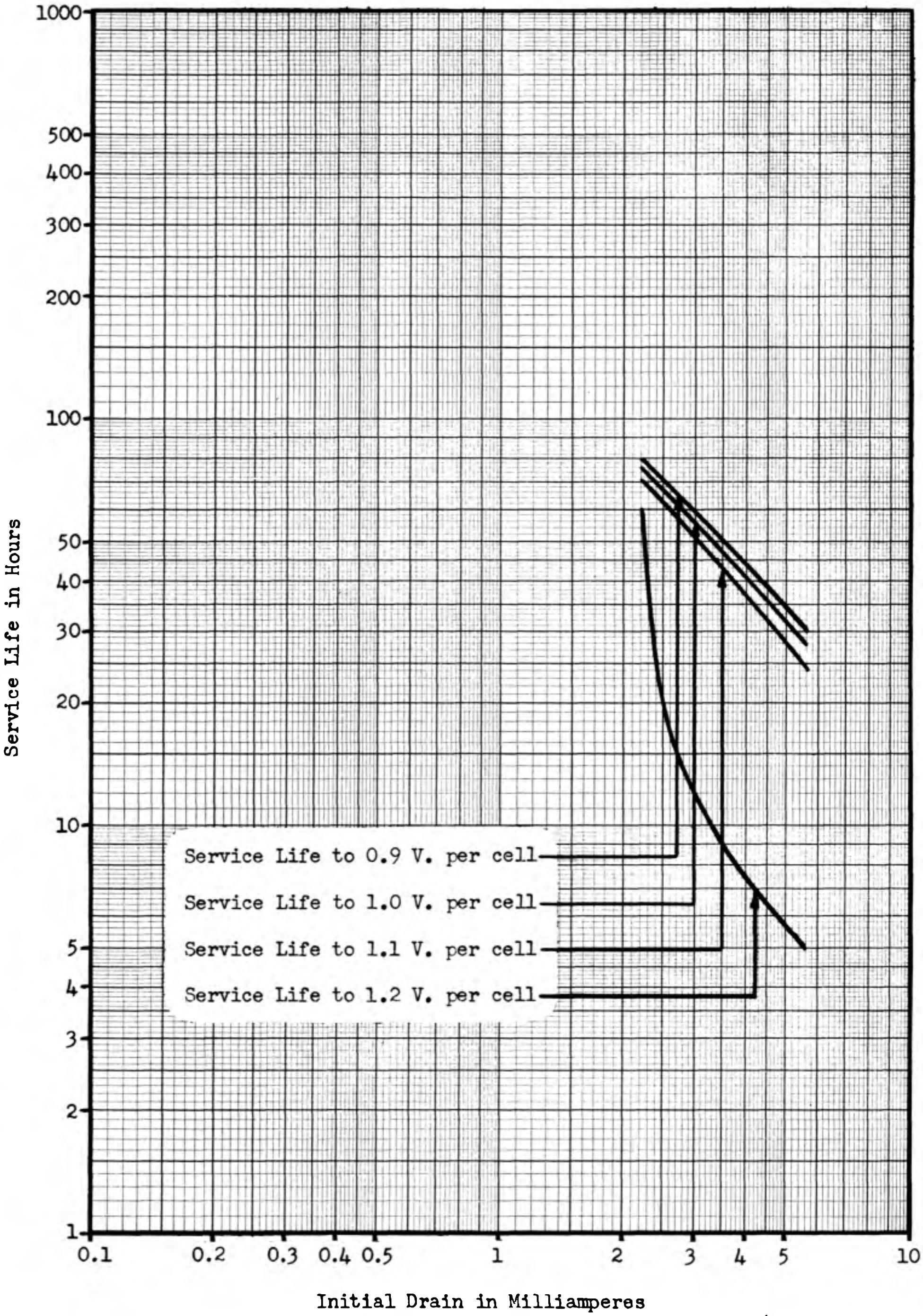
Hg-520 - 902

BURGESS

Hg-675 CELLS

Service Life When
Discharged Continuously
At 70°

MERCURY
GRAPH NO.
4

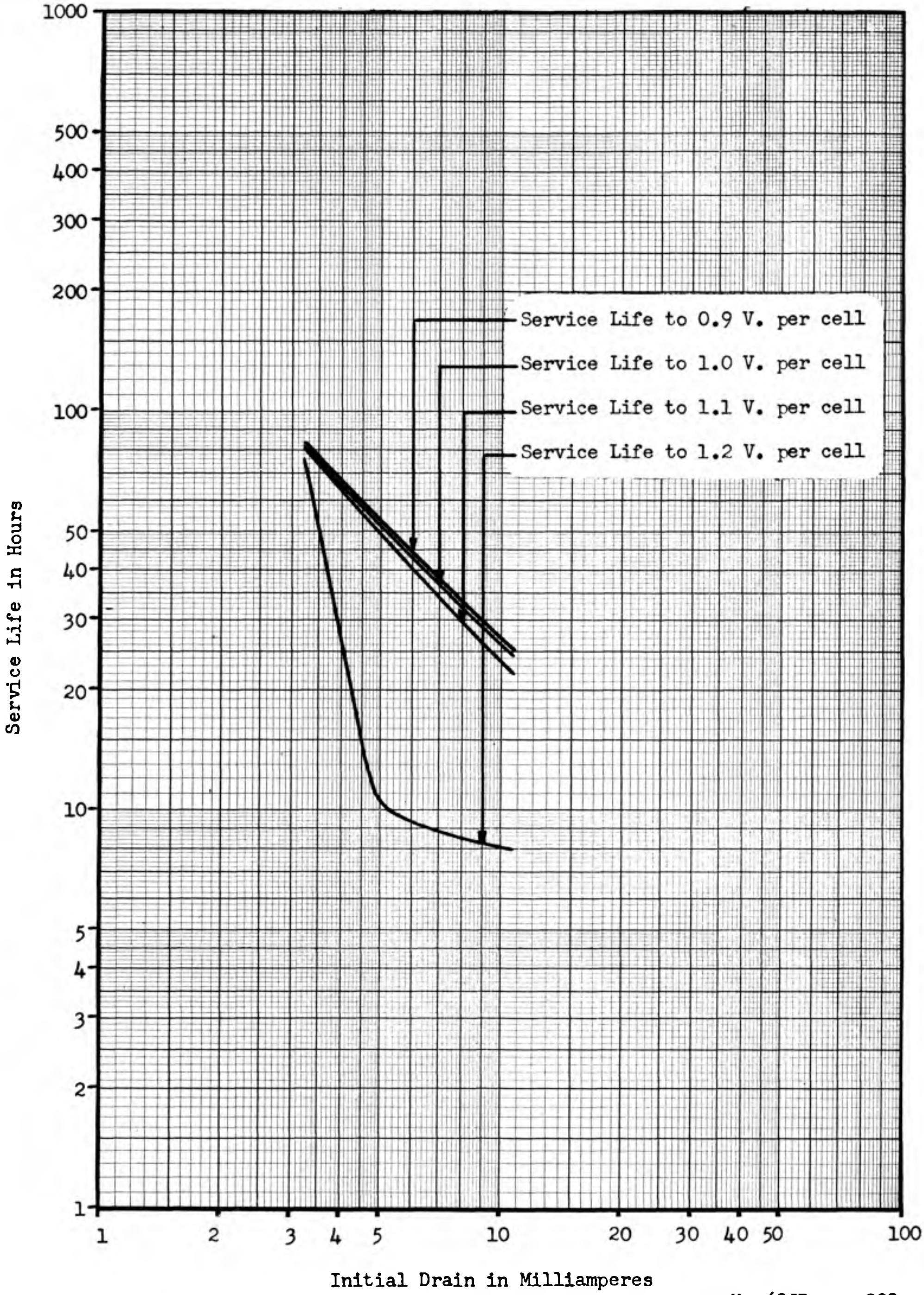


Hg-675 - 902

MERCURY
GRAPH NO.
5

BURGESS
Hg-625R CELLS

Service Life When Discharged Continuously At 70°



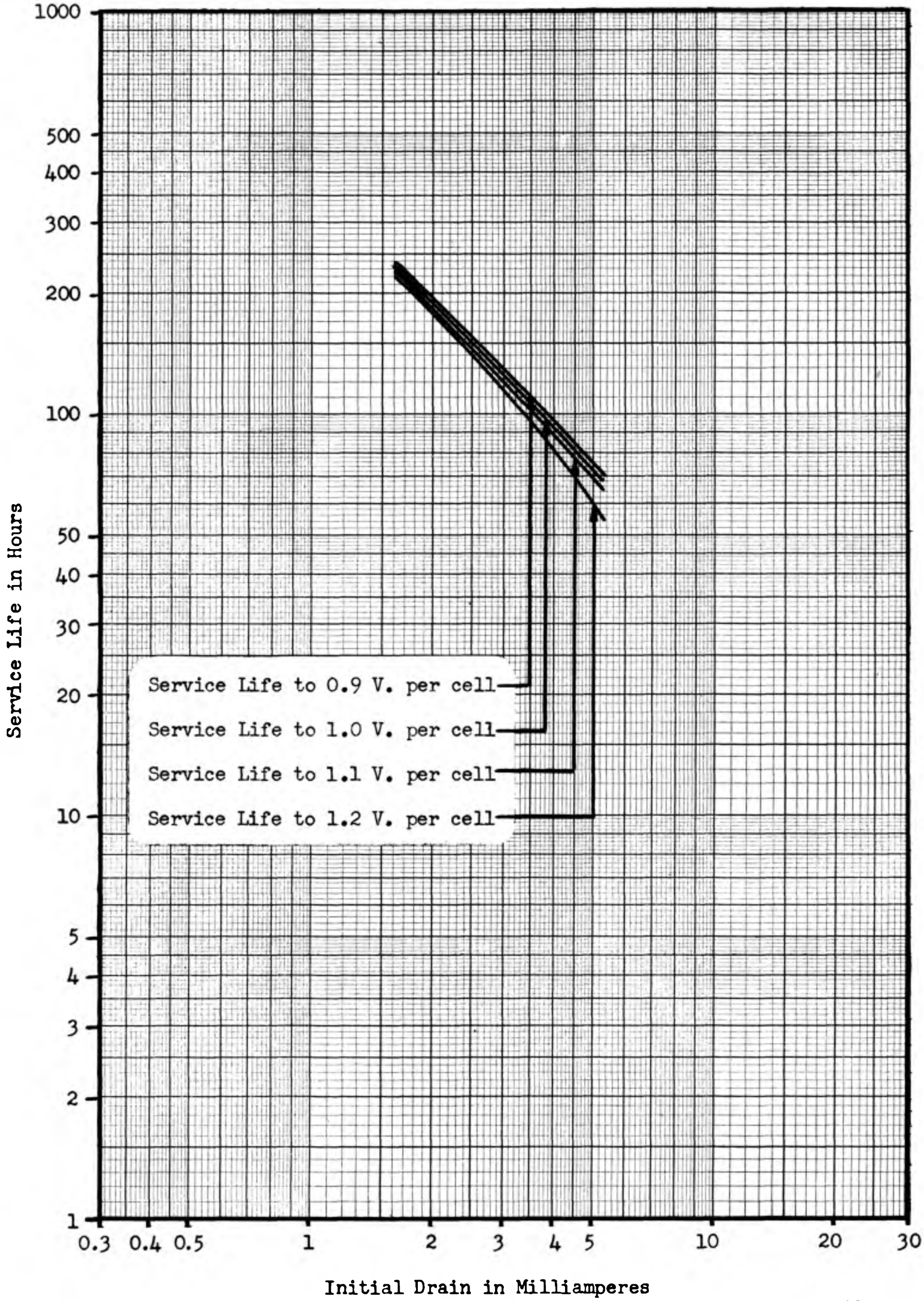
Hg-625R - 902

BURGESS

MERCURY
GRAPH NO.
6

Hg-450R CELLS

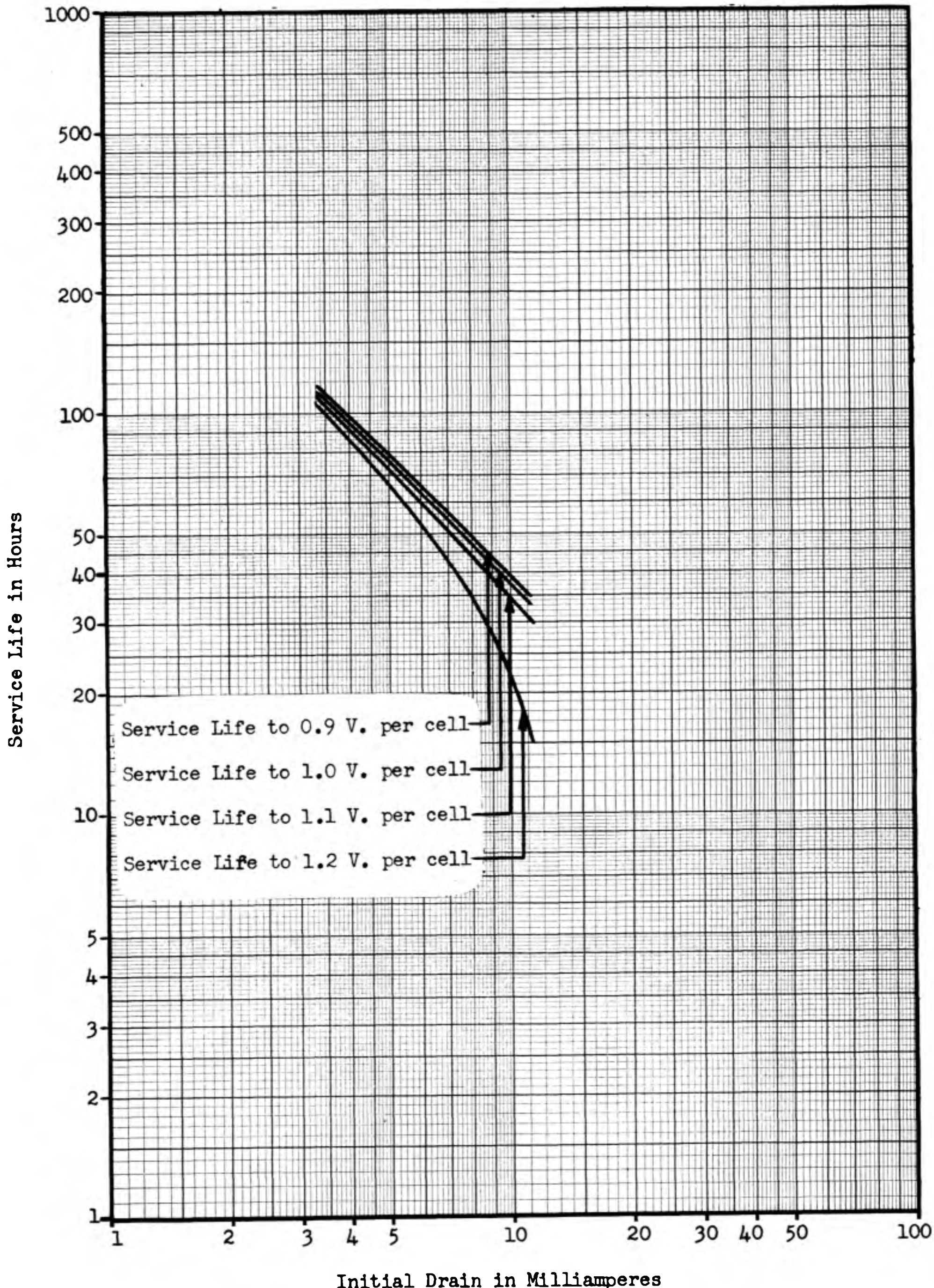
Service Life When Discharged Continuously At 70°



Hg-450R - 902

MERCURY
GRAPH NO.
7

BURGESS
Hg-630 CELLS
Service Life When Discharged Continuously At 70°



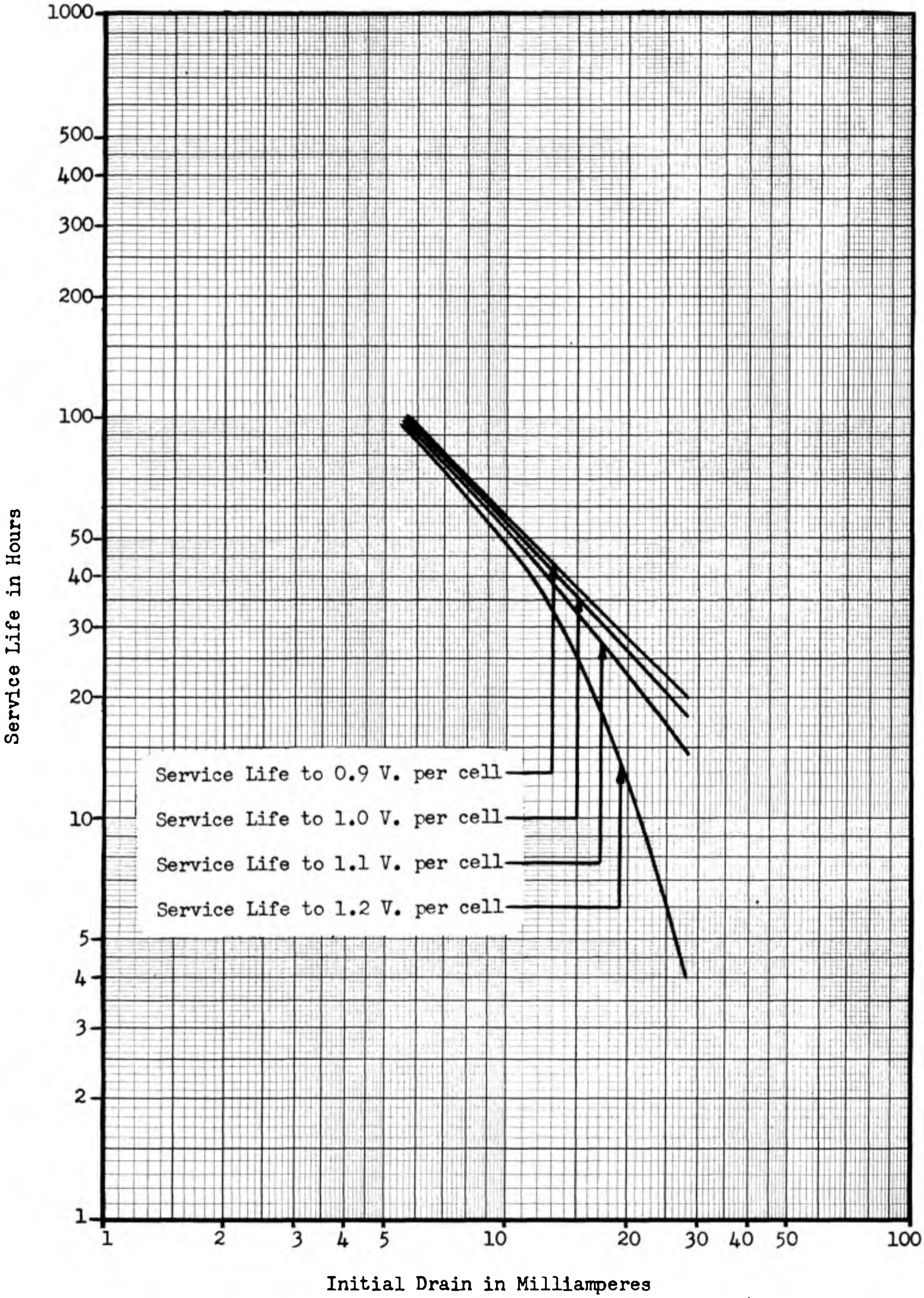
Hg-630 - 902

BURGESS

Hg-640 CELLS

Service Life When Discharged Continuously At 70°

MERCURY GRAPH NO. 8



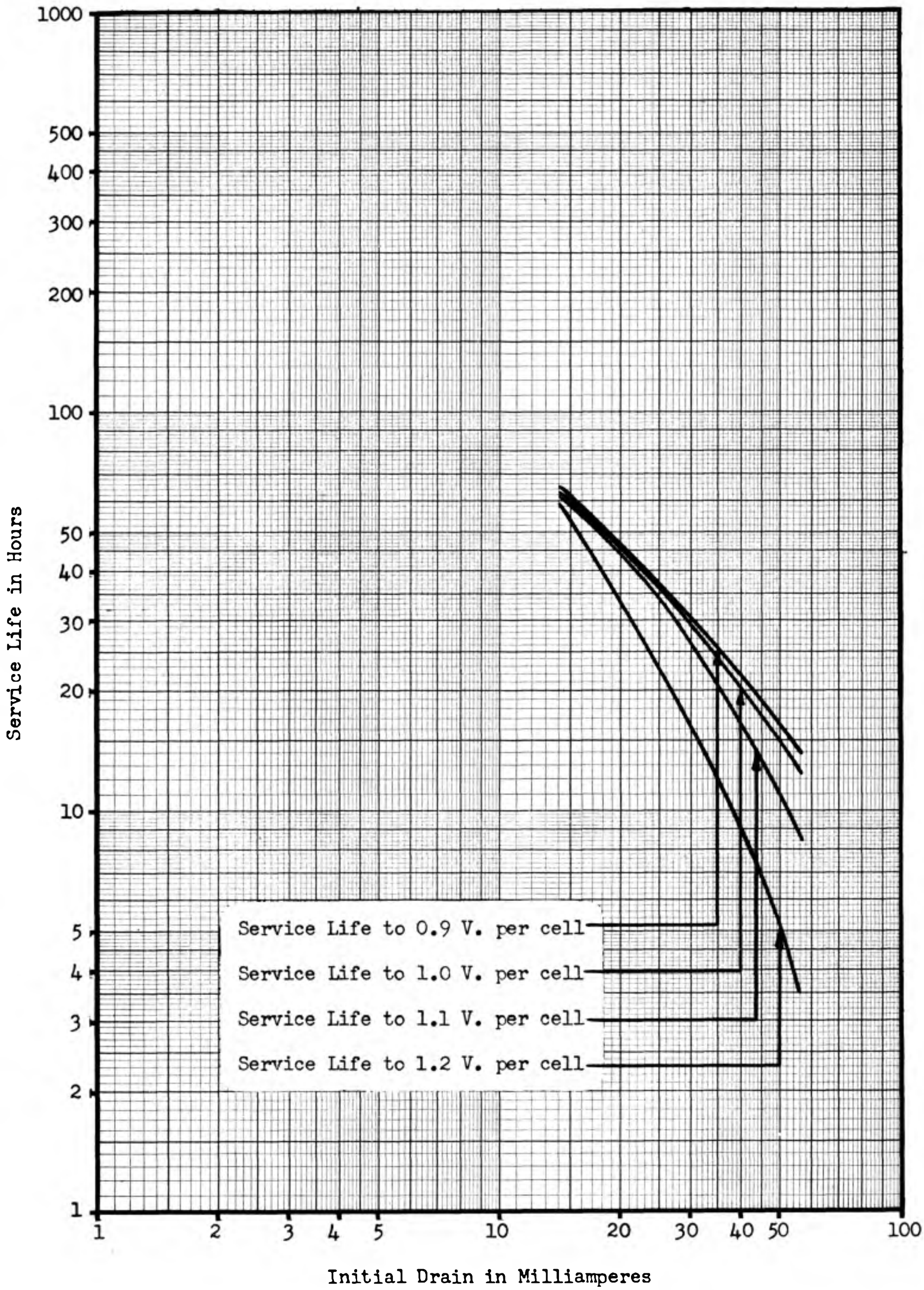
Hg-640 - 902

MERCURY GRAPH NO. 9

BURGESS

Hg-401 CELLS

Service Life When Discharged Continuously At 70°



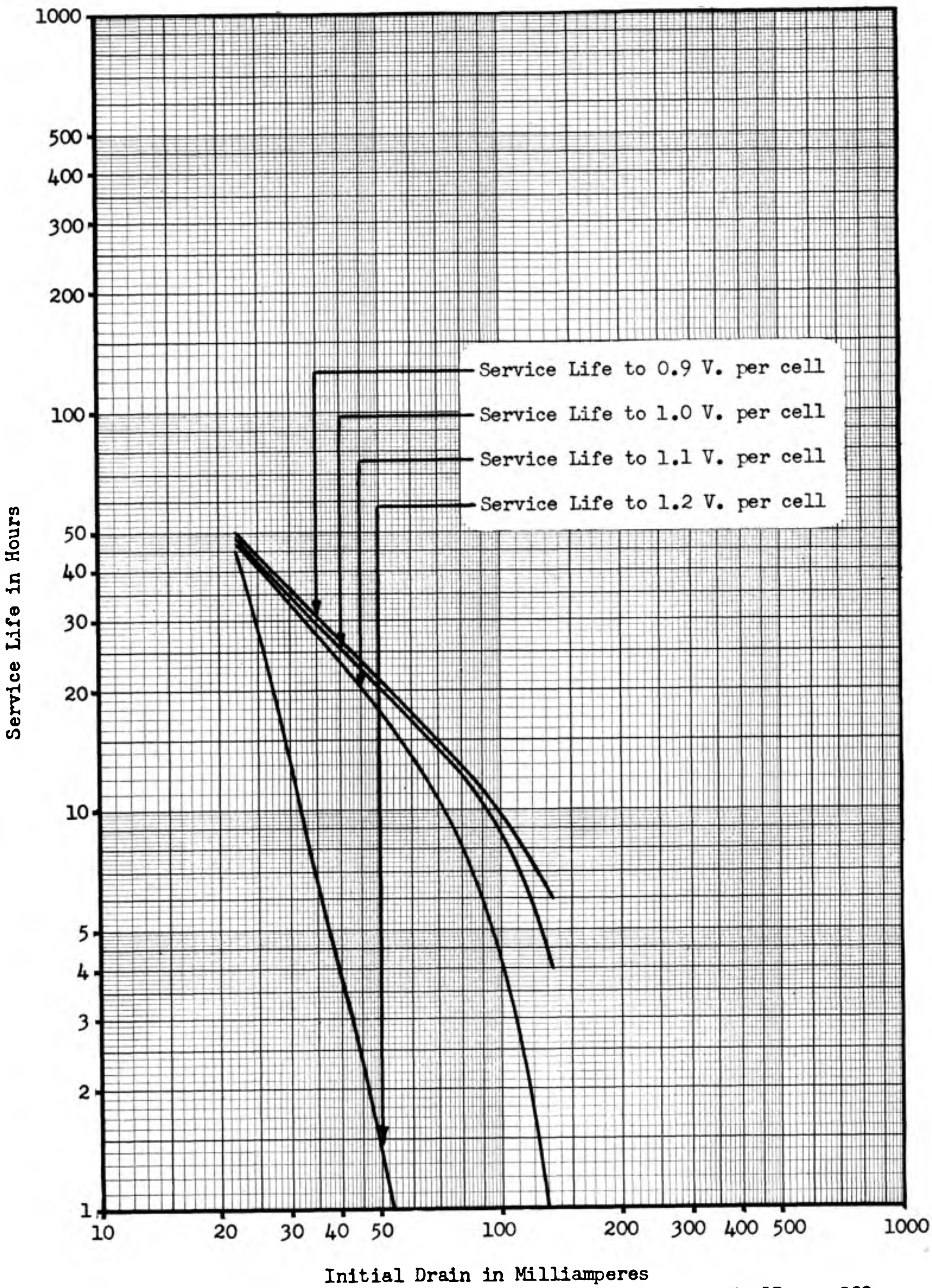
Hg-401 - 902

BURGESS

Hg-1R CELLS

Service Life When Discharged Continuously At 70°

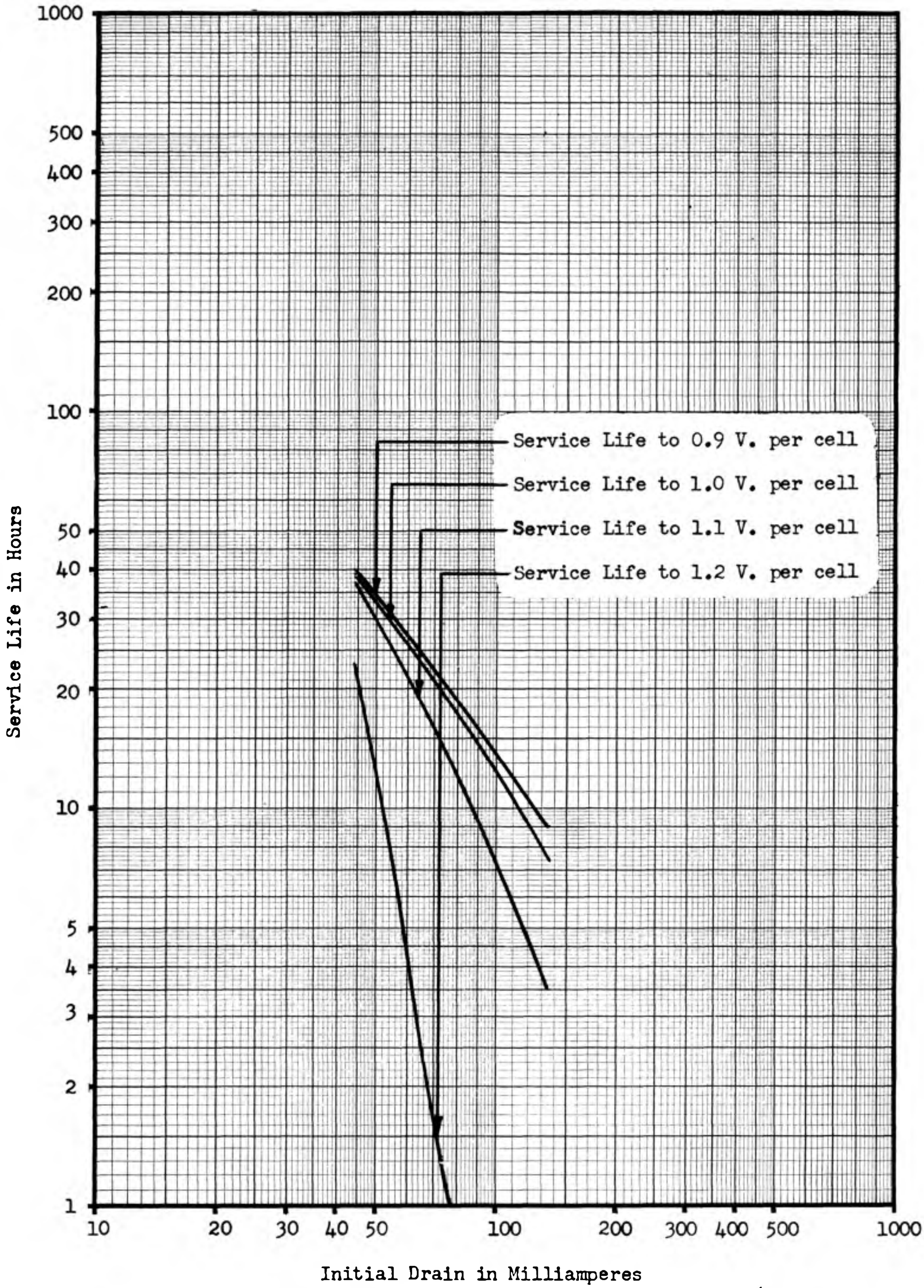
MERCURY GRAPH NO. 10



Hg-1R - 902

MERCURY
GRAPH NO.
11

BURGESS
Hg-601R CELLS
Service Life When Discharged Continuously At 70°



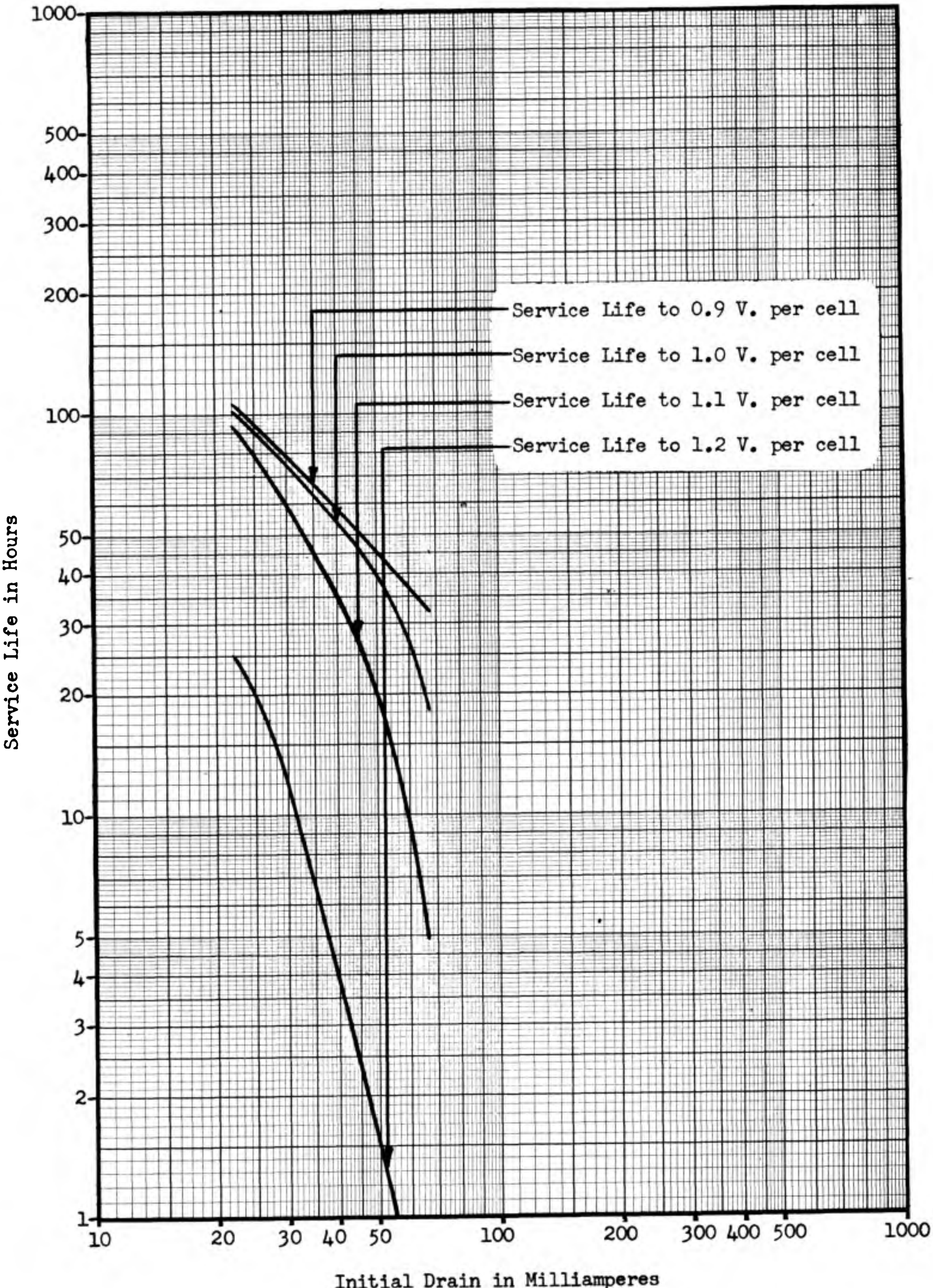
Hg-601R - 902

BURGESS

Hg-3R CELLS

Service Life When Discharged Continuously At 70°

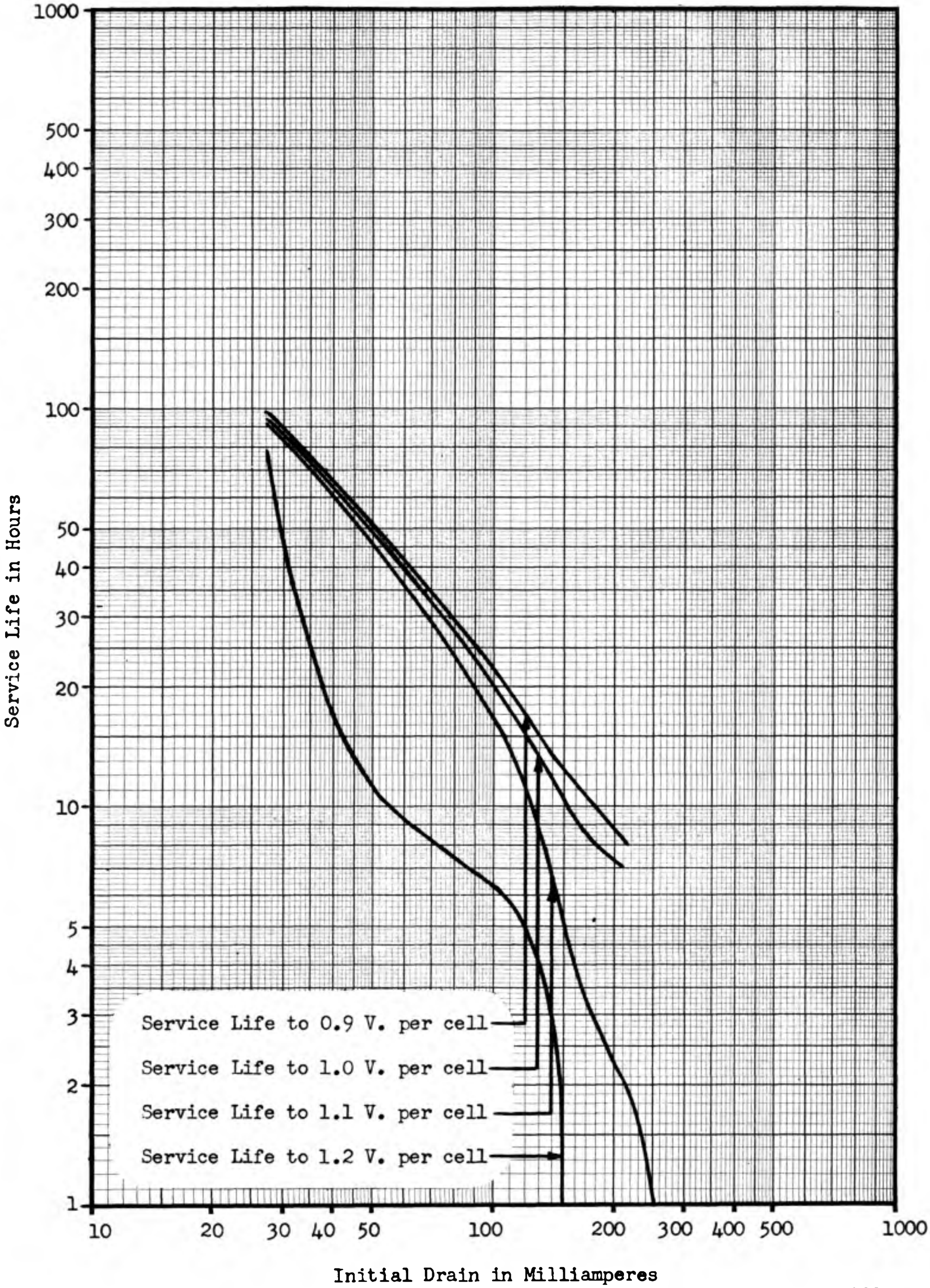
MERCURY GRAPH NO. 12



Hg-3R - 902

MERCURY GRAPH NO. 13

BURGESS
Hg-502R CELLS
Service Life When Discharged Continuously At 70°



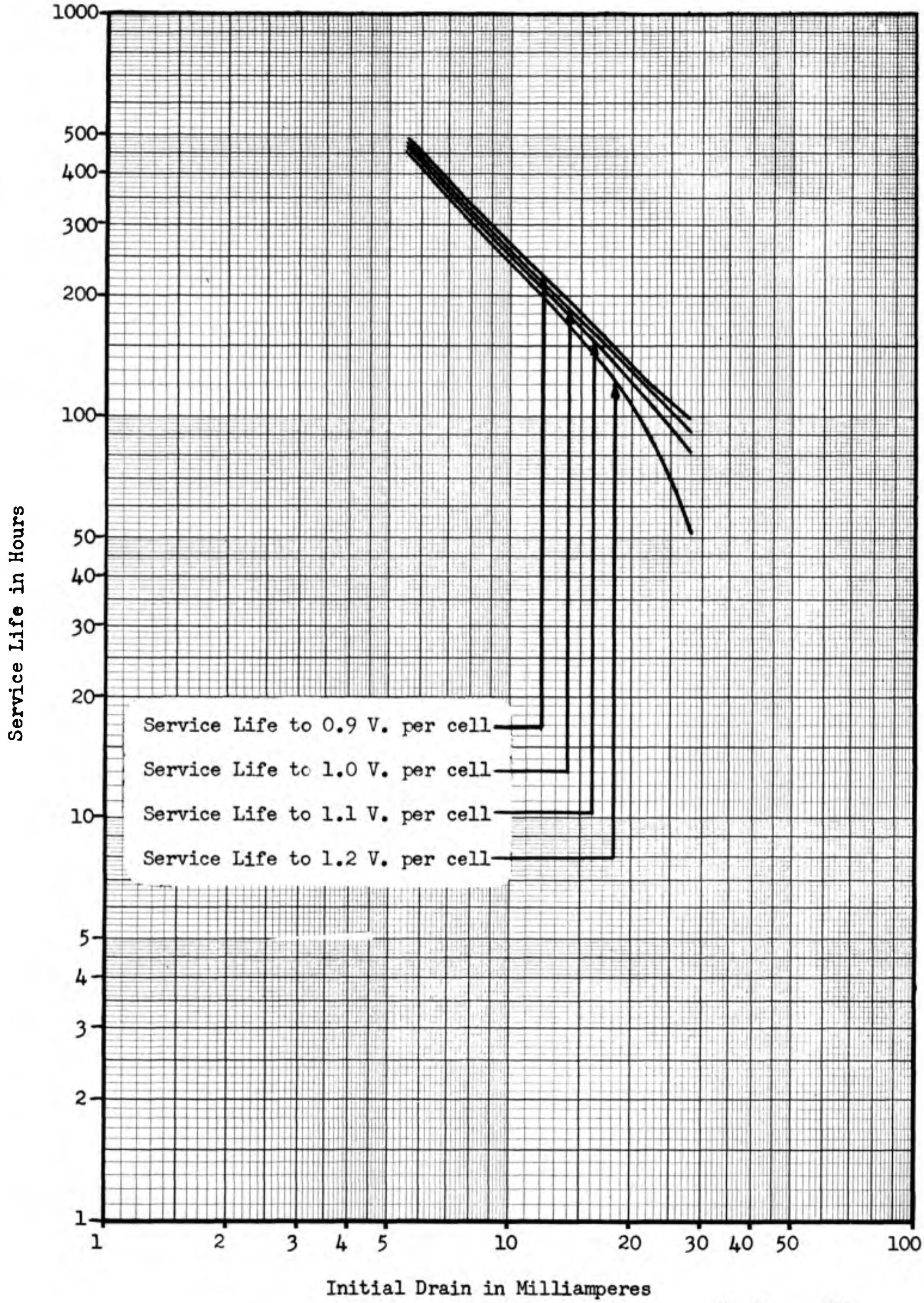
Hg-502R - 902

BURGESS

Hg-9 CELLS

Service Life When Discharged Continuously At 70°

MERCURY GRAPH NO. 14



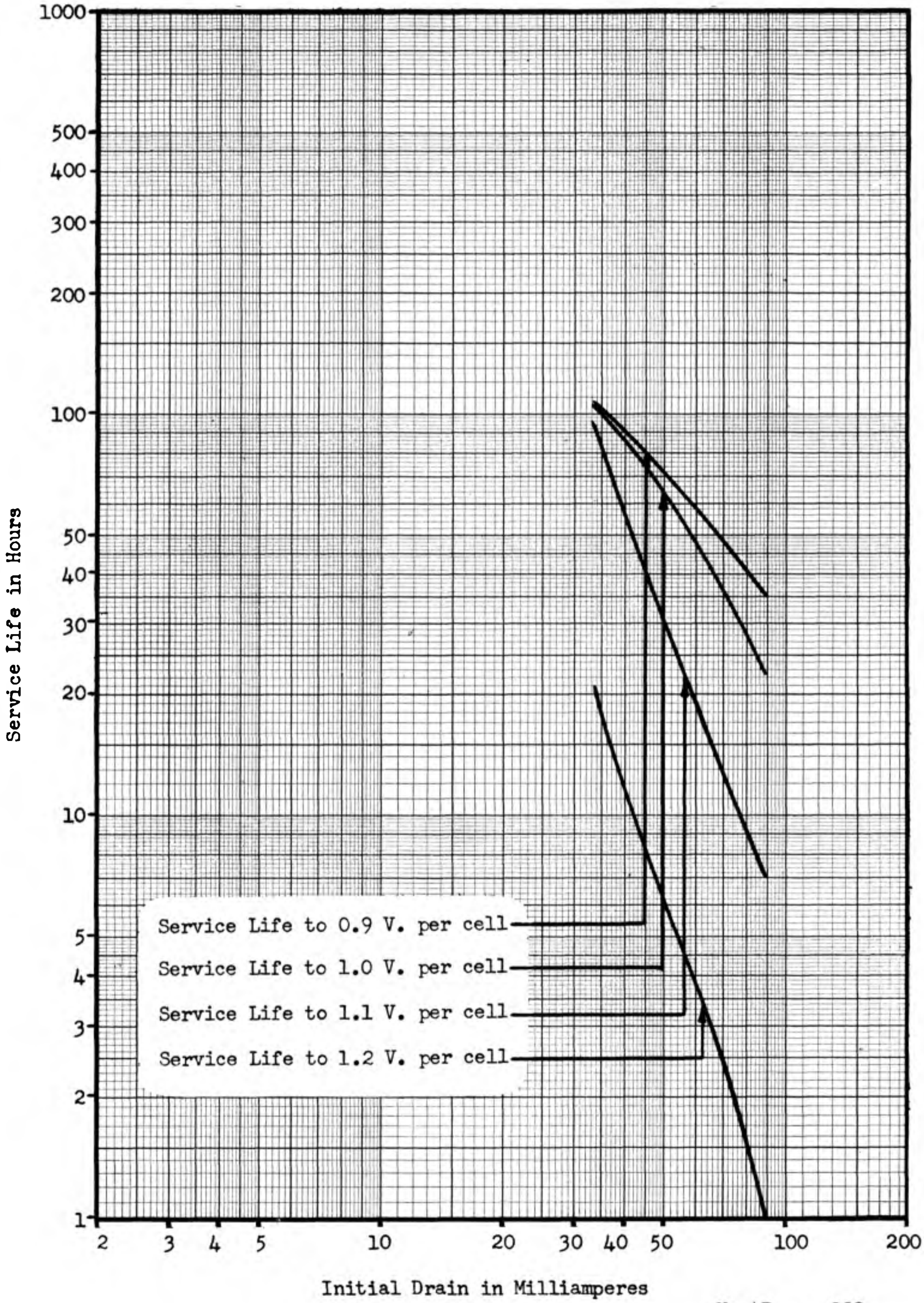
Hg-9 - 902

MERCURY
GRAPH NO.
15

BURGESS

Hg-4R CELLS

Service Life When Discharged Continuously At 70°



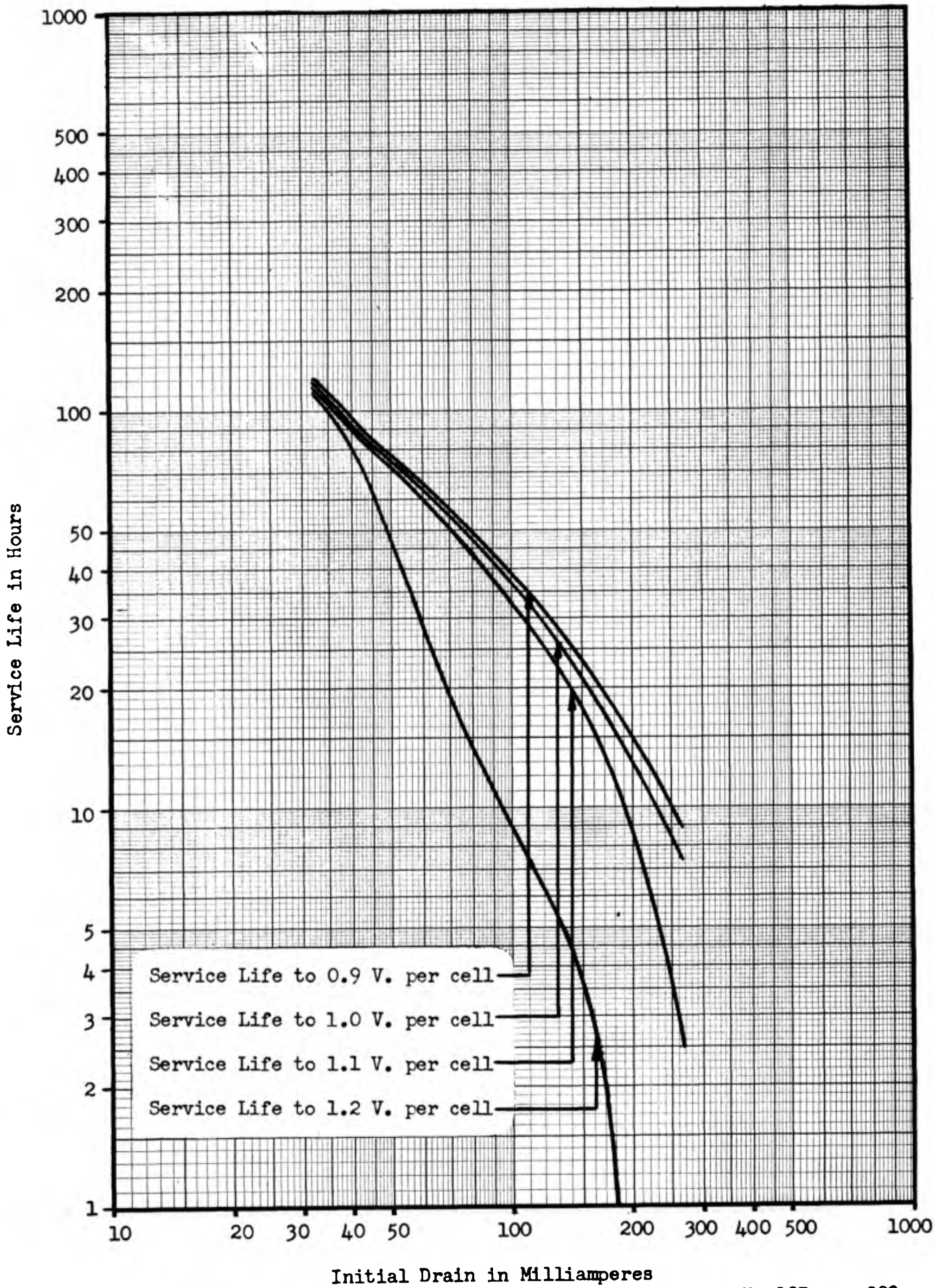
Hg-4R - 902

BURGESS

Hg-12R CELLS

Service Life When Discharged Continuously At 70°

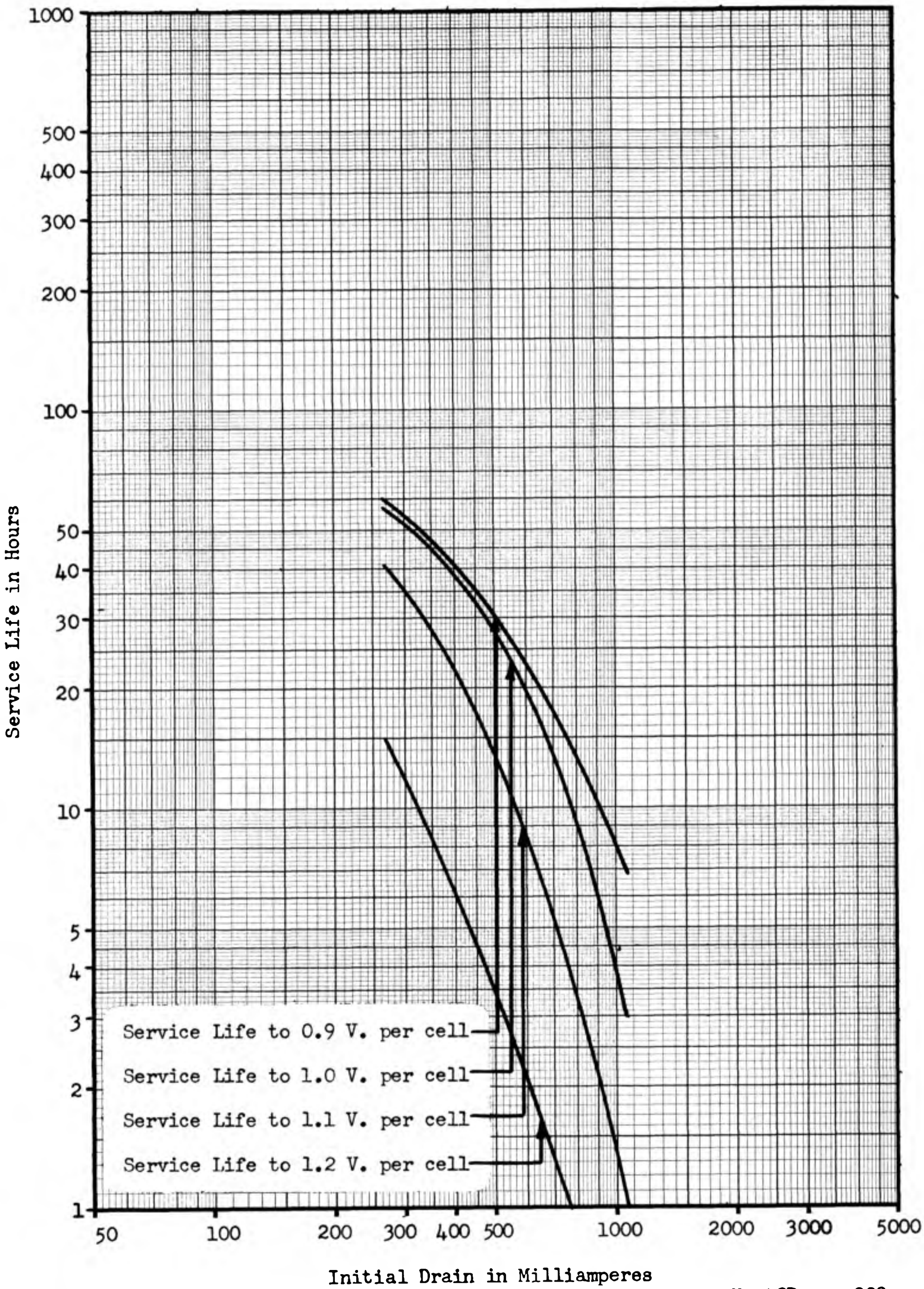
MERCURY GRAPH NO. 16



Hg-12R - 902

MERCURY GRAPH NO. 17

BURGESS
Hg-42R CELLS
Service Life When Discharged Continuously At 70°



Hg-42R - 902

BURGESS RECHARGEABLE, SEALED NICKEL-CADMIUM BATTERIES

Sealed nickel-cadmium batteries bring to the designer of portable equipment the advantages of the rechargeable nickel-cadmium electrochemical system. Their sealed construction makes unnecessary the addition of electrolyte such as is normally required for rechargeable batteries. It also eliminates the problems of corrosive fumes or acids that are usually present with rechargeable batteries.

Each battery is hermetically sealed and requires no maintenance except recharging when its useful life has been exhausted. Recharging will again restore it to peak operating efficiency. Nickel-Cadmium batteries have numerous qualities which lend them to varied applications. Among these are:

1. Rechargeability
2. Nearly constant discharge potential
3. Excellent charge retention
4. Good low temperature characteristics
5. Rugged sealed in steel construction which will stand more abuse than any other cell
6. No electrolyte additions required
7. No corrosive fumes with which to contend
8. Low cost per hour of use

Burgess sealed Nickel-Cadmium batteries can be recharged satisfactorily many times. They may stand for long periods of time in either the charged or discharged state without any adverse effects

Burgess Nickel-Cadmium cells are ruggedly constructed, using expensive, high quality components. They will give satisfactory, economical, trouble free service when used within their recommended ratings in applications where the use of rechargeble cells is justified. Applications which have previously been economically impractical for dry cells due to high energy requirements are now practical and possible with this complete line of rechargeable batteries.

OPERATION OF THE SEALED NICKEL-CADMIUM BATTERY

A secondary cell is a combination of active materials which can be electrolytically oxidized and reduced repeatedly. During discharge, the negative electrode is oxodized and the positive electrode is reduced, the chemical action producing electric power. Both electrode reactions are reversible in the secondary cell, therefore, with proper external current input, the discharge reaction is driven in reverse and the electrodes are recharged. A simplified basic equation of the reaction may be written thus:

$$Cd + Ni\,(OH)_3 \rightleftarrows Cd\,(OH)_2 + Ni\,(OH)_2$$

The sealed cells of button and cylindrical configuration use electrodes which consist of molded screen-encased active materials. In all rectangular cells except the "SP" series the electrodes consists of pressed active materials held in perforated steel pockets locked into welded frames. The "SP" series cells have electrodes of sintered nickel plates impregnated with the active materials.

Nickel-Cadmium batteries generate gas during the latter part of a recommended charge cycle and during overcharge. When the cell is fully charged ond on charge, hydrogen is formed at the cadmium electrode and oxygen is formed at the nickel electrode. In vented type nickel-cadmium batteries the hydrogen and oxygen so generated is liberated to the atmosphere along with entrained electrolyte fumes. In a hermetically sealed nickel-cadmium cell it is therefore necessary to develop means of using up the gas which is generated therein. This is accomplished as follows:

1. The cadmium electrode of the battery is built to provide excess ampere-hour capacity.
2. Assume both electrodes are in the fully discharged state. Charging the battery then causes the positive (nickel) electrode to reach full charge first, at which time it starts generation of oxygen. Due to its excess capacity the negative (cadmium) electrode has not yet reached full charge and cannot cause hydrogen to be generated.
3. The cell is designed to permit the oxygen formed to travel to the surface of the cadmium electrode. There it reacts, forming electrochemical equivalents of cadmium oxide.
4. Thus, when a cell is subjected to overcharge, the cadmium electrode is oxidized at a rate just sufficient to offset input energy and the cell is kept at equilibrium at full charge.

If charged at the recommended charging rate this process can continue for as long as two or three charge cycles without damage to the cell. The charge rate used determines the level of oxygen pressure established in the cell.

Charging at high rates may produce oxygen faster than it can react at the cadmium electrode. This could cause pressures which would rupture the seal.

BATTERY SIZES

These batteries are available in a variety of sizes ranging from the small button type CD1, rated at 1.25 volts and 20 milliampere hours to the large rectangular CD111, rated at 1.25 volts and 23 ampere hours. All sizes are described in detail in the following pages of this manual.

Special batteries not shown here can be made to meet specific requirements.

SERVICE LIFE RATING

The size of sealed nickel-cadmium cells is normally expressed in terms of a nominal milliampere-hour service life such as 20 milliampere-hour size, 50 milliampere-hour size, etc.

METHODS OF EXPRESSING RATE OF DISCHARGE

The conventional method is to speak of the rate in terms such as the "10 hour rate", or the "5 hour rate". By this it is meant that the rate of discharge is such that a battery draining at that rate will deliver its nominal milliampere-hour rating in the length of time used to name the rate.

The following tabulation further illustrates this method of expressing rate of discharge.

Conventional Method	Total Time of Discharge Required to give nominal milliampere-hour Capacity	Milliamperes Drain
10 Hr. rate	10 Hours	$\frac{\text{Nominal ma-hour capacity}}{\text{10 Hours}}$
5 Hr. rate	5 Hours	$\frac{\text{Nominal ma-hour capacity}}{\text{5 Hours}}$
2.5 Hr. rate	2.5 Hours	$\frac{\text{Nominal ma-hour capacity}}{\text{2.5 Hours}}$
1 Hr. rate	1 Hour	$\frac{\text{Nominal ma-hour capacity}}{\text{1 Hour}}$

DISCHARGE CHARACTERISTICS

The discharge curves are quite flat and will stay in the range of 1.20 to 1.25 volts per cell except on heavy drains. A heavy drain would be considered to be about the 5 hour rate or heavier.

Cells should not be discharged to an extremely low closed circuit voltage. Permanent damage may result if this is done. Best results will be obtained when recharging is started when volts per cell have reached about 1.1 volts under load.

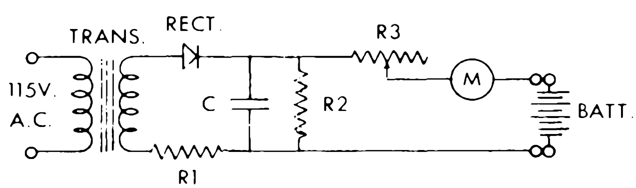
RECHARGING

Cell polarity must be observed or permanent damage may result to the cell. Connections must be made only by pressure contact unless the cell or battery is provided with special solder lugs. Soldering directly to a cell may damage the seal.

Recharging should normally be conducted at the rate in milliamperes which is equal to about 10% of the nominal milliampere hour capacity. Heavier charging rates than this are not recommended. For example, recharge 450 ma.-hr. cell at about 45 milliamperes. Cells should be charged at this rate for about 14 to 16 hours. An occasional charge of as much as twice this amount will not be harmful to the cells.

Nominal Rating	Recommended Charging Rate for 14 - 16 Hrs. Charge	Trickle Charge Rate
20 MAH	2 ma.	0.007 ma.
50 MAH	5 ma.	0.017 ma.
100 MAH	10 ma.	0.034 ma.
150 MAH	15 ma.	0.050 ma.
225 MAH	22.5 ma.	0.075 ma.
450 MAH	45 ma.	0.150 ma.
2500 MAH	250 ma.	0.830 ma.

A typical charging circuit is pictured here.



TRANS. — Transformer, Pri. 115V., Sec. 100V. to 135V.
RECT. — Rectifier, 115V. A. C., Rating as needed.
C — 10 MFD., 150V. D. C. Electrolytic Condenser.
M — Milliameter with range as needed.
R2 — 12000 ohm Resistor, 2 Watts.

CHARGE CURRENT	R1	R3
2 — 15 MA.	1000 Ohms, 10 W.	50000 Ohms, 10 W. Adjustable.
15 — 40 MA.	1000 Ohms, 10 W.	5000 Ohms, 10 W. Adjustable.
40 — 150 MA.	250 Ohms, 10 W.	1000 Ohms, 25 W. Adjustable.
150 — 250 MA.	100 Ohms, 10 W.	250 Ohms, 25 W. Adjustable.

During a floating charge the maximum voltage should be in the range of 1.33 to 1.45 volts per cell. Except for Trickle Charging, the charging recommendations made here assume the cell has been completely discharged to about 1.1 volts under load. In instances where cells are not completely discharged (example, about ½ of the available mah capacity used) the length of the charging period should be adjusted to put back into the cell about 140% of the energy removed by the preceding discharge period.

RETENTION OF CHARGE

When a fully charged cell is allowed to stand idle it will gradually lose its charge. This loss is hastened considerably by high temperatures. The following table illustrates this.

Approximate Retention of Charge Expressed as % of Initial Capacity When Stored at Various Conditions

Storage Conditions

Storage Period	131°F. and 100% R.H.	125° F. Dry	113° F. Dry	70° F.	40° F.
Initial	100%	100%	100%	100%	100%
1 mo.	20%	30%	60%	88%	95%
2 mo.	5%	25%	32%	82%	90%
3 mo.	0	0	18%	80%	89%
6 mo.	0	0	0	67%	89%
12 mo.	0	0	0	41%	79%

Cells which are allowed to stand idle are not harmed by the gradual self discharge that takes place. They may be restored to full operating performance by recharging by the methods previously described.

TEMPERATURE CHARACTERISTICS

These cells and batteries are not recommended for use beyond the range of 0° F. to 115° F. Excessively low or high temperatures may cause leakage.

The following tabulation shows the effect of discharge temperature on service life cells discharged at the "10 Hour Rate."

Discharge Temperature	Approximate Percent of 70° F. Capacity
113° F.	93%
70° F.	100%
40° F.	93%
28° F.	88%
—4° F.	60%

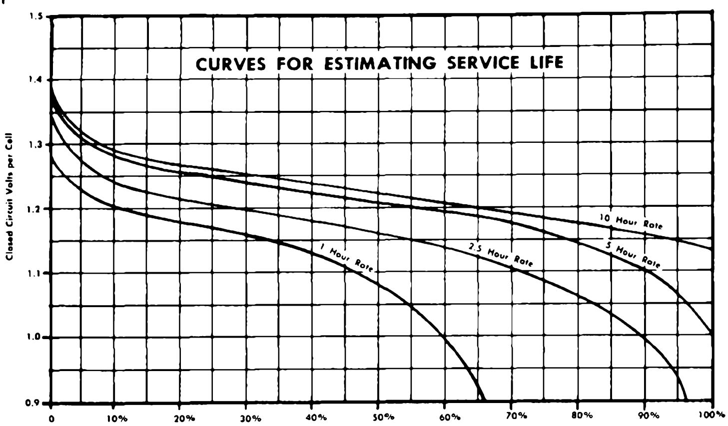
NORMAL LIFE

The life of the cell or battery is based on the drain and nature of its discharge cycles. If the battery is only partially discharged (½ to ¾ of its capacity) on each cycle, then the number of cycles possible before the battery's usefulness is ended, is extended.

Where discharges completely exhaust a cell the cycle life can be considerably less. Where the recommended cut-off of 1.1 volts is observed hundreds of cycles should be obtained. Also, when cells are operated according to recommended procedure, termination of cell life will not be sudden. Rather, a gradual decline in capacity will result, allowing replacement on an orderly schedule.

ESTIMATING SERVICE LIFE

This may best be done by use of the Service Life Curves. The follow- examples illustrate the use of these curves.



% of Nominal MAH capacity or % of time period used to designate rate, ie.

% of 10 Hrs. for 10 hr. rate

% of 5 Hrs. for 5 hr. rate

% of 2.5 hrs. for 2.5 hr. rate

% of 1 hr. for 1 hr. rate

EXAMPLE:

How long will a 225 milliampere-hour cell discharge at 45 milliamperes to 1.15 volts?

$$\frac{\text{225 Milliampere-Hours}}{\text{45 Milliamperes}} = \text{5 Hours}$$

Hence, a drain of 45 ma. on this cell results in discharge at the "5 hour rate". Reference to the "5 hour rate" curve shows 80% of the normal milliampere-hour capacity to 1.15 volts. Thus the cell will discharge for:

$$0.8 \times \text{5 hours} = \text{4 Hours (answer)}$$

EXAMPLE:

What cell will be required to furnish 2.5 hours of service at 80 milliamperes to an end point of 1.1 volts?

The milliampere-hour output of the cell must be 2.5 hours $\times$ 80 ma. = 200 milliampere-hours.

Reference to the list of cells available shows two sizes that might meet this requirement, namely the 225 ma.-hr. and the 450 ma.-hr. sizes.

First check the 225 ma.-hr. size cell to determine whether it will meet the requirement.

$$\frac{\text{225 ma.-hr. nominal size}}{\text{80 ma. drain}} = \text{2.8 hr. rate}$$

In other words, at a drain of 80 ma. on the 225 ma.-hr. cell, the cell is discharging at about 2.8 hour rate. There is no curve shown for this rate, but by interpolation it can be estimated from the curves that about 75% of the nominal ma.-hr. capacity will be obtained to 1.1 volts at the 2.8 hour rate.

$$75\% \times \text{225 ma.-hr.} = \text{169 ma.-hr.}$$

This is less than the 200 ma.-hr. required. Therefore, the 225 ma.-hr. cell is too small. For this application the 450 ma.-hr. cell must be used. To check further:

$$\frac{\text{450 ma. hr.}}{\text{80 ma.}} = \text{5.63 hr.}$$

At this drain the 450 ma.-hr. cell would be discharging at about 5.63 hour rate. Interpolating from the curve, we estimate at this rate the cell should give about 83% of the nominal service 93% $\times$ 450 ma.-hr. = 418 ma.-hr.

This is more than double the 200 ma.-hr. required. Thus, the 450 ma.-hr. cell should give two discharge periods of 2.5 hours before recharging is required.

BURGESS Sealed Nickel Cadmium
1.25 Volt Types

No. CD1

No. CD2

No. CD8

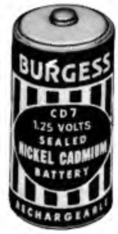
No. CD3

No. CD4

No. CD5

No. CD6

No. CD9



No. CD7
No. CD10
No. CD11

Battery No. (In order of Increasing Physical Size)	Nominal Capacity in Ma.-Hrs.	Drain in Milliamperes at 10 Hour Rate	Maximum Size (Inches)		Maximum Weight		Charging Rate for 14-16 Hour Charge (ma)	Terminal Type
			Diameter	Height	Lbs.	Gms.		
NOMINAL 1.25 VOLT BATTERIES								
CD1	20	2	0.460	0.225	0.0030	1.4	2	Flashlight
CD2	50	5	0.610	0.236	0.0058	2.7	5	Flashlight
CD8	100	10	0.984	0.232	0.0200	9	10	Flashlight
CD8L	100	10	0.984	0.257	0.0200	9	10	Solder Lugs
CD3	150	15	0.984	0.275	0.0205	9.3	15	Flashlight
CD3L	150	15	0.984	0.300	0.0205	9.3	15	Solder Lugs
CD4	225	22.5	0.984	0.350	0.0256	11.6	22.5	Flashlight
CD4L	225	22.5	0.984	0.375	0.0256	11.6	22.5	Solder Lugs
CD5	450	45	1.700	0.300	0.0667	30.2	45	Flashlight
CD5L	450	45	1.700	0.325	0.0667	30.2	45	Solder Lugs
CD6	450	45	0.560	1.950	0.0475	21.5	45	Flashlight
CD6L	450	45	0.560	2.275	0.0475	21.5	45	Solder Lugs
CD9	900	90	0.550	3.680	0.087	39.3	90	Solder Lugs
CD7	2500	250	1.300	2.425	0.313	142	250	Flashlight
CD7L	2500	250	1.300	2.775	0.313	142	250	Solder Lugs
CD10	4000	400	1.300	2.425	0.313	142	400	Flashlight
CD10L	4000	400	1.300	2.775	0.313	142	400	Solder Lugs
CD11	3000	300	1.300	2.425	0.313	142	300	Flashlight
CD11L	3000	300	1.300	2.775	0.313	142	300	Solder Lugs
*CD12	1200	120	0.876	1.672	0.110	49	120	Flashlight
*CD13	2300	230	1.273	1.440	0.190	87	230	Flashlight

NOTE: Cells marked "L" have terminals for making soldered connections to the cell. All other cells must have connections made by pressure contacts only, since soldering directly to these cells would damage the seals. *Not Illustrated

BURGESS Sealed Nickel Cadmium
6 Volt Types

No. CD21

No. CD22

No. CD23

No. CD30

No. CD31

PHYSICAL DESCRIPTION

Battery No. (In order of Increasing Physical Size)	Cells Used		Nominal Capacity in Ma.-Hrs.	Drain in Milliamperes at 10 Hour Rate	Maximum Size (Inches)			Max. Weight		Charging Rate for 14-16 Hour Charge (ma)	Terminal Type
	Number	Size			Diameter		Height	Lbs.	Gms.		
NOMINAL 6 VOLT BATTERIES											
CD21	5	CD3	150	15	1.065		1.525	0.115	52	15	Lug
CD22	5	CD4	225	22	1.065		1.975	0.145	66	22	Lug
CD23	5	CD5	450	45	1.800		1.725	0.375	170	45	Lug
					L.	W.	H.				
CD30	5	CD9	900	90	1½	1½	3 13/16	0.50	227	90	Flexible Leads
CD31	5	---	1500	150	3 13/16	1 17/32	3⅝	1.70	770	150	Flexible Leads

BURGESS Sealed Nickel Cadmium
9.6 and 12 Volt Types

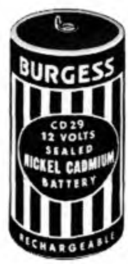
No. CD24

No. CD25

No. CD26

No. CD27

No. CD28



No. CD29

PHYSICAL DESCRIPTION

Battery No. (In order of Increasing Physical Size)	Cells Used		Nominal Capacity in Ma.-Hrs.	Drain in Milliamperes at 10 Hour Rate	Maximum Size (Inches)		Max. Weight		Charging Rate for 14-16 Hour Charge (ma)	Terminal Type
	Number	Size			Diameter	Height	Lbs.	Gms.		
NOMINAL 9.6 VOLT BATTERIES										
CD24	8	CD3	150	15	1.065	2.650	0.180	82	15	Large Snap
CD25	8	CD4	225	22	1.065	3.200	0.225	104	22	Large Snap
CD26	8	CD5	450	45	1.800	2.575	0.560	254	45	Lug
NOMINAL 12 VOLT BATTERIES										
CD27	10	CD3	150	15	1.065	2.925	0.220	100.	15	Lug
CD28	10	CD4	225	22	1.065	3.600	0.280	127	22	Lug
CD29	10	CD5	450	45	1.800	3.100	0.740	335	45	Lug

BURGESS Sealed Nickel Cadmium
Prismatic 1.25 Volt Types

No. CD100

No. CD101

No. CD102

No. CD103S

No. CD104

No. CD105

No. CD106S

No. CD107

No. CD108

No. CD109

No. CD110

No. CD111

All Prismatic type cells use uninsulated welded steel outer case. The steel case is polorized positive for all Prismatic type cells. Prismatic cells are provided with a safety vent which operates to relieve pressure if cell is misused.

PHYSICAL DESCRIPTION

Battery No. (In order of Increasing Ampere Hrs.	Nominal Capacity in Ampere Hours	Drain in Amperes at 10 Hour Rate	Maximum Size (inches)			Maximum Weight	Charging Rate for 14 to 16 Hour Charge (amperes)	Terminal Type
			Length	Width	Height	Lbs.		
CD100	1.5	0.15	1.36	0.75	3.36	0.35	0.15	Binding Post
CD101	2.0	0.20	1.36	1.36	2.40	0.37	0.20	Binding Post
CD102	3.5	0.35	1.36	1.36	3.36	0.57	0.35	Binding Post
CD103S	4.0	0.40	1.57	0.92	4.01	0.61	0.40	Binding Post
CD104	4.5	0.45	1.93	1.67	3.13	0.77	0.45	Binding Post
CD105	6.0	0.60	1.93	1.67	3.65	0.95	0.60	Binding Post
CD106S	7.0	0.70	1.57	1.48	4.01	0.87	0.70	Binding Post
CD107	7.5	0.75	1.93	1.67	4.25	1.10	0.75	Binding Post
CD108	11.0	1.10	3.56	1.05	4.90	1.76	1.10	Binding Post
CD109	15.0	1.50	3.56	1.34	4.90	2.20	1.50	Binding Post
CD110	19.0	1.90	3.56	1.66	4.90	2.58	1.90	Binding Post
CD111	23.0	2.30	3.56	1.97	4.90	3.12	2.30	Binding Post

Discharge Voltage — Average 1.22 Volts
Final 1.10 Volts

BURGESS RESERVE TYPE POWER UNITS

A New type of Highly Portable Power Supply

GENERAL TYPES

Two types of RESERVE TYPE POWER UNITS are available, one using a curpous chloride-magnesium system and one using a silver chloride-magnesium system. The cuprous chloride batteries are used where economy is an important factor, such as to power radiosonde, emergency lights or other equipment. They have a shelf life of 5 years or more when kept sealed from humidity.

The silver chloride batteries are used where size, weight, and/or rapid build up to operating voltages are the important factors. These batteries also have a shelf life of 5 years or more when kept sealed from humidity. However, they also have a shelf life of several months when exposed to relative humidity as high as 90%. This type is used extensively to power sonobuoys and emergency equipment on ships and planes.

CONSTANT VOLTAGE

Whatever its load, the energy output of RESERVE TYPE POWER UNITS is relatively constant. Typical discharge curves are shown in Figure 1.

LIGHT WEIGHT

In most cases, replacing generators or ordinary batteries with RESERVE TYPE POWER UNITS, will mean a considerable reduction in weight. In a high-intensity lighting unit the weight was reduced more than 50% by the use of RESERVE TYPE POWER UNITS, and at the same time a brighter and more constant light was obtained. In another case, where storage batteries weighing over 20 pounds had been recommended, a RESERVE TYPE POWER UNIT weighing only 7½ pounds was used successfully.

LONG SHELF LIFE

RESERVE TYPE POWER UNITS are supplied in dry form and are normally shipped in sealed containers.

Since they are free from moisture, no deterioration occurs in storage and the shelf-life is 5 years or more. The power units can be built into the equipment that they will operate and will be ready to operate whenever they are needed. Silver chloride type batteries are available that will withstand relative humidity as high as 90% for several months.

WIDE TEMPERATURE RANGE

While RESERVE TYPE POWER UNITS must be activated at temperatures above the freezing point of water, they can be successfully discharged at ambient temperatures as low as −80°F. The heat produced within the battery keeps it from freezing. Temperatures as high as 150°F are not detrimental.

METHODS OF USE

RESERVE TYPE POWER UNITS are shipped in dry form and are readily activated when they are required for use. Batteries that are to be operated submerged are merely placed in the water, sea water, lake water, etc., in which they are to operate. Batteries that are to be operated out of the activating liquid are simply immersed in tap water or sea water for one to two minutes to saturate the cells. Then they are removed and are ready to operate. The batteries may be designed to operate with any type of water such as common tap water, lake water, sea water, or distilled water.

The load can be connected either before or after activation. The batteries will not start to discharge until they have been activated.

RESERVE TYPE POWER UNITS must normally be used within a period of several hours after activation. However, RESERVE TYPE BATTERIES are available that can be used over a period of several weeks. It is not normally possible, for example, to dry out the unit and then re-activate at a later date. They are a "one shot" source of power and are not re-chargeable after use.

SERVICE AND SIZE ESTIMATES

Watt-hours per cubic inch or per pound vary with the design life of the battery. Batteries designed for 1 hour life are less efficient in terms of space and weight than those designed for longer service.

The following values are applicable to silver chloride-magnesium type batteries, operating totally immersed.

(1) Watt-hours per cubic inch vary from:
Design life 1 hour — 2.95 watt-hrs. / cu. inch
to Design life 72 hours — 4.2 watt-hrs. / cu. inch

(2) Watt-hours per pound, based on dry weight, vary from:
Design life 1 hour — 45 watt-hrs. / pound
to Design life 72 hours — 70 watt-hrs. / pound

The following values apply to cuprous chloride-magnesium type batteries, operated out of water, battery design life, 15 hours.

(1) Watt-hours per cubic inch — 0.86

(2) Watt-hours per pound
Based on activated weight — 23 watt-hrs. / pound
Based on dry weight — 41 watt-hrs. / pound

ENGINEERING SERVICE

RESERVE TYPE POWER UNITS must normally be designed for each specific application. Send your inquiry to Engineering Department S, Burgess Battery Company, Freeport, Illinois. Include with your inquiry the information requested on page 131.

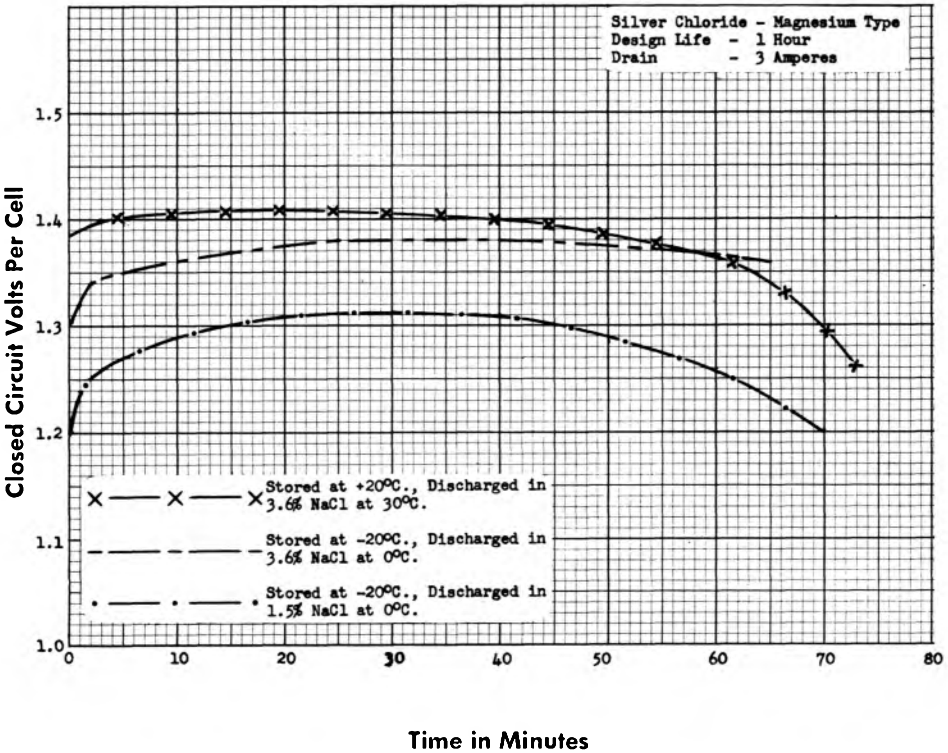


FIGURE 1 — Typical discharge curves for Silver Chloride-Magnesium type batteries discharged under various conditions of temperature and water salinity.

BURGESS

BURGESS BATTERY COMPANY
DIV. OF SERVEL, INC.
Freeport, Illinois

CHECK SHEET FOR NEW BATTERY DESIGN

(For use with Carbon-Zinc, Mercury and Sealed Nickel Cadmium Types)

Listed below is information on the characteristics of a battery we need for special purpose uses. It is understood that you will send us full details before developmental work is started.

APPLICATION: ____________________

____

NOMINAL VOLTAGE: ____________________

END POINT VOLTAGE: (Closed circuit voltage at which battery must be replaced) ____________________

INITIAL CURRENT DRAIN: (Amperes or Milliamperes) ____________________

TYPE OF LOAD: (Resistor, Filament, etc.) ____________________

DISCHARGE SCHEDULE: (Continuous, 4 Hr. per day, etc.) ____________________

____

DESIRED BATTERY LIFE: __________ WEIGHT (Max.) __________

DESIRED PHYSICAL DIMENSIONS (in inches):

Width __________ Body Height __________

Length __________ Overall Height __________

TYPE OF TERMINALS ____________________

LOCATION OF TERMINALS ____________________

OPERATING TEMPERATURE __________ STORAGE PRIOR TO USE __________

STORAGE TEMPERATURE __________

REMARKS (Special features not covered above): ____________________

____

COMPANY NAME ____________________

ADDRESS ____________________

CITY __________ ZONE ______ STATE __________

SEND TO ATTENTION OF: ____________________

Use opposite side for sketches

(Cut along dotted line)

BURGESS BATTERY COMPANY

DIVISION OF SERVEL, INC. FREEPORT, ILLINOIS

RESERVE BATTERY SPECIFICATION SHEET

(Cut along dotted line)

Customer ____________________

Address ____________________

Engineer in Charge of Project ____________________

Nature of Application: ☐ Motor ☐ Vibrator ☐ Vacuum Tube ☐ Resistor Load

Voltage:		A.	B.	
Normal	______	______	______	______
Max. (if any)	______	______	______	______
Minimum	______	______	______	______
Taps	______	______	______	______
Resistance of Load:	______	______	______	______
Current:	______	______	______	______
Life Desired on Load:	______	______	______	______

Load connected ☐ before ☐ after activation.

Time on open circuit after activation ____________________

Weight limit ______ (Battery, battery case, and electrolyte only).

Is buoyancy in water a factor? ____________________

Space available (dimensions) ____________________

Is water available for activation? ____________________

☐ Fresh ☐ Sea ☐ Limited Amount ☐ Unlimited

Can the battery be immersed manually in the activating water prior to use? ______

Storage Conditions ____________________

Operating Conditions: Temperature range ______ °F. to ______ °F.

Humidity range ______ % to ______ %

Pressure range ______ (atmospheric)

Vibration or Shock Conditions (describe): ______

Will the Battery be Submerged during Operation? ____________________

Can the Battery be Activated at a Temperature above Freezing? ______

____

Other information ____________________

____

USING 4½, 6 AND 12 VOLT POWER SUPPLIES

No. TW3 with spot beam
No. TW5 with flood beam

No. TW4 with spot beam
No. TW6 with flood beam

No. TW6E with flood beam
No. TW4E with spot beam

No. TW4S with spot beam
No. TW6S with flood beam

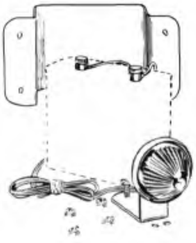
No. TW7 Chrome Finish
No. TW8 Copper Finish

No. TW9

No. TW11

No. TW12

No. TW34 with Flasher
No. TW35 without Flasher



No. TW36

No. JR1

No. BK100

PHYSICAL DESCRIPTION ON FOLLOWING PAGE

PHYSICAL DESCRIPTION

	BATTERY		LAMP			
				RATING		
Number	No.	Volts	No.	Volts	Amps.	Type of Beam
TW3 (Tail Lamp)	TW1	6.0	*4546	4.7	0.50	Sharp Spot
	TW1	6.0	407 Flasher	4.9	0.30	Warning Flash
TW5 (Tail Lamp)	TW1	6.0	*4512	4.7	0.50	Flood Beam
	TW1	6.0	407 Flasher	4.9	0.30	Warning Flash
TW4	TW1	6.0	*4546	4.7	0.50	Sharp Spot
TW6	TW1	6.0	*4512	4.7	0.50	Flood Beam
TW4E	TW1	6.0	*4546	4.7	0.50	Sharp Spot
TW6E	TW1	6.0	*4512	4.7	0.50	Flood Beam
TW4S	TW1	6.0	*4546	4.7	0.50	Sharp Spot
TW6S	TW1	6.0	*4512	4.7	0.50	Flood Beam
TW7	TW1	6.0	1651	5.0	0.60	360 Degree Illumination
TW8	TW1	6.0	1651	5.0	0.60	360 Degree Illumination
TW9	TW1	6.0	425	5.0	0.50	Focusing Spot
TW11	TW1	6.0	425	5.0	0.50	Focusing Spot
TW12	TW2	12.0	965	9.84	0.50	Wide Angle Spot
TW34	TW1	6.0	407 Flasher	4.9	0.30	Warning Flash
TW35	TW1	6.0	502	5.1	0.15	Warning Flare
TW36	TW1	6.0	502	5.1	0.15	Warning Flare
JR1	Three No. 2	4.5	PR-3	3.57	0.50	Sharp Spot
BK100 Sternlight	TW1	6.0	502	5.1	0.15	360 Degree White Illumination
BK100 Running Light	TW1	6.0	27	4.9	0.30	Red & Green Running Bow Light

* Sealed Beam Type