Principal Symbols and Abbreviations.

Quantity	Symbol	Unit	Abbr.
Capacity; (rated or nominal)	C	ampere - hour	Ah.
Current	I	ampere	A
Electromotive force (e.m.f.)	E	Volt.	V
Energy	W	watt - hour	Wh
		Kilowat - hour	kWh
Frequency	f	cycle per second	C/P
Power	P	watt	W
		kilowatt	kW
Resistance	R	ohm	Ω
		megohm	MΩ
Time	T	second	sec.
		minute	min.
		hour	hr.
Voltage	V	Volt	V

Specific Gravity. Difference between readings are of ten expressed in points. Thus 1.280 - 1.260, or 0.030 is 30 points.

Ampere	-	Amp.
Battery	-	Bty.
Circuit	-	ckt.
Degree Centigrade	-	°C.
Degree Fahrenheit	-	°F.
Specific Gravity	-	sp.gr.
Temperature	-	Temp.

Battery Terminology.

Active Materials. Materials of plates reacting chemically to produce electric energy during the discharge. The active material of storage cells are restored to their original composition, in the charged condition, by oxidation or reduction process produced by the charging current. In the charged condition the active materials are as follow:

Positive Plate - Lead dioxide (PbO_2).
Negative Plate - Sponge Lead (Pb).

Activation. process of wetting the cell with electrolyte to make the cell ready for operation.

Ampere - Hour Capacity. The number of ampere - hour which can be delivered by a cell or battery under specified conditions as to temperature rate of discharge and final voltage.

Average Voltage. The average voltage of the voltage during the period of charge or discharge. It is conveniently obtained from the time integral of the voltage curve.

Battery. An arrangement of two or more cells, usually series connected, to supply the necessary voltage or current, or both.

Boost Charge. A partial charge, usually at a high rate for a short period.

Capacity. The quantity of electricity, usually expressed in ampere - hour, which may be taken from a cell at a particular rate of discharge under specified conditions of voltage and temperature. Unless otherwise specified, the term " Capacity " may be used to describe the standard

rating of a plate or cell. (output capability over a period of time; expressed in ampere - hours).

Cell. Basic - Unit for conversion of chemical energy to electrical energy and also for the reverse precess for rechargeable units.

Cell Connector. A conductor used for carrying current between adjacent cells.

Case. A container for several cells. Specifically wood cases are containers for cells in individual jars; rubber or composition cases are provided with compartment for the cells.

Charge. The conversion of electric energy into chemical energy within the cell or battery. This consists of the restoration of the active materials by passing a unidirectional current through the cell or battery in the opposite direction to that of the discharge. A cell or battery which is said to be " charged " is understood to be fully charged.

Charge, state of. Condition of a cell interms of the capacity remaining in the cell.

Charging. Process of supplying electrical energy for conversion to stored chemical energy

Charging Rate. The current expressed in ampere at which a battery is charged.

Closed - Circuit Voltage. The voltage at the terminals of a cell or battery when current is flowing.

Constant - Current Charge. A charge in which the current is maintained at constant value. For some types of lead batteries this may involves two rates called the starting and the finishing rates.

Constant - Voltage Charge. A charge in which the voltage at the terminals of the battery is held at a constant value. A modified constant voltage system is usually one in which the voltage of the charging circuit is held substantially constant, but a fixed resistance is inserted

in the battery circuit producing a rising voltage characteristic at the battery terminals as the charge progresses. This term is also applied to other methods for producing automatically a similar characteristic.

Container. A box of glass, of ebonite or of other suitable plastics material in which the plate groups and separaters are assembled.

Counter Electromotive Force Cells. Cell of practically no capacity used to oppose the line voltage. Frequently called " Counter cells."

Couple. The element of a cell containing two plates, one positive and one negative. This term is also applied to a positive and negative plate connected together as one unit for installation in adjacent cells.

Critical Temperature. The temperature of the electrolyte at which an abrupt change in capacity occurs.

Cutoff Voltage. Voltage at the end of useful discharge. See end-point voltage.

Cycle. One sequence of discharge and charge.

Deep Discharge. Withdrawl of all electrical energy to the end-point voltage before cell or battery is recharged.

Discharge. The conversion of the chemical energy of the battery into electric energy (withdrawal of electrical energy from a cell or battery, usually to operate connected equipment).

Discharge. The connection of a cell to an external circuit in such a way that the current flows through the cell in the reverse - direction to that of charge. The quantity of electricity thus taken out is known as the discharge, and is usually measured in ampere - hours.

Drain. Withdrawal of current from a cell.

Dry. Indication that the electrolyte in a cell is immobilized, being either in the form of a paste or gel or absorbed in the separator material.

Dry Charge. Process by which electrodes are assembled in a cell in a charged state. With addition of electrolyte, the cell can be discharged.

Dry Shelf life. Period of time that a cell can stand without electrolyte before deteriorating beyond a point where a specified capacity or voltage level can be obtained.

Efficiency. The ratio of the output of a cell or battery to the input required to restore the initial state of charge under specified conditions of temperature, current rate, and final voltage. The efficiency of a battery - energy input versus energy output - can vary very widely depending upon the circumstances of use. A small amount of energy is required to maintain it, even without any use, so that the greater the amount of proper use, the higher the efficiency. Nominally the relation between a normal discharge and the necessary recharge is the basis on which efficiency is considered.

This may be expressed in two ways - as the ampere - hour efficiency, or the watt hour efficiency. In terms of ampere hours, it is usually considered that the recharge should equal 110 % of the discharge giving an efficiency of about 91 %. However the average voltage on charge is considerable higher than on discharge in an approximate proportion of 17 - 18 % giving a voltage efficiency of 85 %. Combining these two 0.91 x 0.85 results in a watt - hour (or total energy) efficiency of 77.78 % which can be considered as a representative figure.

Electrolyte. Solution that permits ionic conduction between anode and cathode or that takes part in the chemical reaction in a cell. An aqueous solution of sulphuric acid used in lead cells. The concentration of the solutions varies somewhat with the type of cell, its use and condition. The electrolyte of charged cell at 70°F (21°C) will ordinarily fall within the following nominal limits of specific gravity.

	Lead - acid cells
maximum ———	1.300
minimum ———	1.200

Element. The positive and negative groups with separaters assembled for a cell.

End Cells. The cells of a battery which may be out in or out of the circuit for the purpose of adjusting the battery voltage.

End - point voltage. Cell voltage below which the connected equipment will not operate or below which operation is not recommended.

Energy. Output capability; expressed as capacity times voltage, of watt - hours (w - hr).

Energy Density. ratio of cell energy to weight or volume (w - hr per lb or w - hr per cu.in.)

Equalizing Charge. n extended charge given to a battery to insure the complete restoration of the active materials in all the plates of all the cell.

s inferred else where, it is necessary that a battery be brought to a state of full charge in order to avoid excess sulphation yet appreciable over - charge must also be avoided. To accomplish this it is common practice to stop daily or other frequent recharges when the battery is nominally but not completely recharged, and then give a periodic " equalizing charge." This is simply a continuation of a regular charge until a complete state of charge is attained. In theory such a charge should be continued until sucessive readings of gravity and voltage show no increase over a period of several hours. In practice it is ucually done by continuing the charge by time - clock for a certain period which experience has shown to be adequate.

The fre uancy of these equalizing charges varies with the service application - form weekly in industrial cycle service, to serveral months in standby floating service.

Final Voltage. The prescribed voltage upon reaching which the discharge is considered complete. The final voltage is usually chosen so that the useful cap city of the cell is realized. Final voltage vary

with the type of battery, the rate of the discharge, temperature and the service in which the battery is used.

Finishing Rate. The rate of charge expressed in amperes to which the charging current for some types of lead batteries is reduced near the end of charge to prevent excessive gassing and temperature rise.

Floating. method of operation in which a constant voltage is applied to the battery terminals sufficient to maintain an approximately constant state of charge.

Float charging. Method of recharging in which a secondary cell is continuously connected to a constant voltage supply that maintains the cell in fully charged condition.

Floating Trickle Charge. The operation of a battery in paralle with a load and a charging source at such an applied voltage that the battery takes a charge from the charging source which is sufficient to maintain the cells in a fully charged condition indefinitely.

Gassing. As mentioned elsewhere, a battery cell cannot absorb all the energy from the charging current toward the end of charge, and the excess energy dissociates water by electrolysis into its component gases hydrogen and oxygen. The oxygen is liberated at the positive plates and the hydrogen at the negative. When a battery is completely charged, all of the energy, except the small resistance loss, is consumed in this electrolysis.

During a recharge, gassing is first noticed when the cell voltage reaches 2.30 - 2.35 volts per cell and increases as the charge progresses. t full charge when most of the energy goes into gas, the amount of hydrogen liberated is about one cubic foot per cell for each 63 ampere hours input. In as much as 4 % content of hydrogen in the air m y be hazardous, the above value m y be used to relate the maximum amount from a given battery to the size of the rooms in which it is located

Grid. metallic framework for conducting the electric current and supporting the active material.

Group. Assembly of a set of plates of the same polarity for one cell

High - Rate Discharge. Withdrawal of large currents for short intervals of time, usually at a rate that would completely discharge a cell or battery in less than 1 hr.

Initial drain. Current that a cell or battery supplies at nominal voltage.

Internal resistance. Opposition to current flow within a cell (ohms).

Lead - Acid Cell. A cell in which the electrolyte is dilute sulphuric acid and which is fitted with plates in which the active materials are:

1) Positive electrode : lead dioxide
2) Negative electrode : sponge lead.

Low - Rate Discharge. Withdrawal of small currents for long periods of time, usually longer than 1 hr.

Mossing. This is the term used to describe the possible deposition of a spongelike layer of lead on the negative plates or straps. This material was originally shed from the plates (mostly the positives) in very fine particles and circulated throughout the cell by gassing, falling on both the positive and negative plates, when in contact with either plate it is changed to the active material of that plate. That on the positive is " loss " and non cohesive in native and simple washes off again from the gassing of the cell. Such material on the negative plate, however, is cohesive in nature and thus adheres to and builds up on the top edge and possibly along the side edges of the plate. It can accumulate to such an extent that it bridges over or around the separators, touching an adjacent positive plate and causing a partial short circuit.

The accumulation of any appreciable amount of moss is usually an indication of over-charging in ampere hours and or high charging current in amperes either of which should, of course, be corrected.

Negative Plate. The grid and active material to which the current flows from the external circuit when the battery is discharging.

Nominal Voltage. Voltage of a fully charged cell when delivering rated capacity.

Open - Circuit Voltage. The voltage of a cell or battery at its terminals when no current is flowing. For the purpose of measurement, the small current required for the operation of a voltmeter is usually negligible.

Pilot Cell. A selected cell whose temperature, voltage and specific gravity of electrolyte are assumed to indicate the condition of the entire battery.

Plate. The unit which, singly or in groups, is submerged in the electrolyte so that it forms the whole or part of one of the electrodes of the cell.

1) Positive plate. The plate which forms the anode or part of the anode during charge.

2) Negative plate. The plate which forms the cathode or part of the cathode during charge.

Plate Group. A complete electrode consisting of either positive or negative plates, together with group bar and terminal pillar.

Polarity. An electrical condition determining the direction in which current tends to flow. By common usage the discharge current is said to flow from the positive or dioxide plate through the external circuit.

Polarization. The change in voltage at the terminals of a storage cell, when a specified current is flowing.

Positive Plate. The grid and active material from which the current flows to the external circuit when the battery is discharging.

Primary. Cell or battery which cannot be recharged efficiently or safely after any amount of discharge.

Rating. The ampere - hour capacity of a positive plate or cell, assigned to it by the maker, under specified condition of discharge.

Rechargeable. Capable of being recharged; refers to secondary cells or batteries.

Reference Temperature. The capacity obtained from a storage battery on discharge varies with the temperature of the electrolyte. The following standard references temperatures are established:

1) The temperature of electrolyte at beginning of discharge shall be 25°C (77°F). No limit is placed on the temperature attained by the electrolyte during discharge.

2) The ambient temperature on discharge shall be from 5°C to 8°C lower than the temperature of the electrolyte, on the beginning of discharge. The ambient temperature shall be kept const nt throughout the discharge.

Secondary. Cell or battery which can be recharged after being discharged under specified conditions of use.

Separator. A device for preventing metallie contact between the plates of opposits polarity within the cell chemically treated wood formerly used for this purpose has now been almost entirely replaced by improved performing mechnical separators. These include resin impregnated cellulose fiber types also microporous rubber and other plastics used both alone and in combination with glass fiber mats as well as flat glass fiber sheets with a microporous backing.

Separators have ribs on the side facing the positive plates to provide greater acid volume next to the positives, for reasons of improved officiency, and to facilitate acid circulation within the cell. The ribs also minimize the area of contact with the positive plate which has a highly oxidizing effect on most separators. Class fiber retainer mats or perforated rubber or other plastic sheets are sometimes placed between the positive plate and the separator to retard the loss of active material from the plate and to protect the separator from oxidation.

Shelf life. For a dry cell, the period of time (measured from the date of manufacture), at a storage temperature of 70°F, after which the cell retain a specified percentage (usually 90 percent) of its original energy content. Also see wet shelf life.

Specific Gravity of Electrolyte. The electrolyte of lead - acid batteries increases in concentration to a fixed maximum value during charge and decreases during discharge. The concentration is usually expressed as the specific gravity of the solution affords an approximate indication of the state of charge.

The specific gravity of sulphuric acid in battery is measured with hydrometer. The hydrometer reading varies in accordance with the temperature, therefore a specific gravity measured at any must be corrected to the standard temperature of 20°C (68°F).

The variation is - 0.0007/°C (1.8°F) with 20°C (68°F) as the standard; that is to say, the specific gravity falls by 0.0007/°C or $\frac{0.0007}{1.8}$ /°F with the temperature above 20°C (68°F) while it rise by $\frac{0.0007}{1.8}$ /°F with the temperature below 20°C (68°F).

The method to correct the specific gravity at a certain temperature to the standard temperature of 20°C (68°F) is as follows :-

$$S_{20} = S_t \quad 0.0007\ (t - 20) \text{ or } S_t = S_{20} - 0.0007\ (t - 20)$$

where: S_{20} = Specific gravity of dilute sulphuric acid corrected to 20°C (68°F)

S_t = Specific gravity of dilute sulphuric acid measured at t°C.

t = Temperature of dilute sulphuric acid read by celcius scale.

Stationary Batteries. Are those designed for services in a permanent location.

Sterage Battery. A connected groups of two or more electrochemical cells after being discharged may be restored to a charged condition by an electric current flowing in a direction opposite to the flow of current when the battery discharged. Common usage permits this desination to be applied to a single cell used independently.

Trickle Charging. Method of recharging in which a secondary cell is either continuously or intermittently connected to a constant - current supply that maintains the cell in fully charged condition.

Volt Efficiency. The ratio of the average voltage during the discharge to the average voltage during the recharge.

Watthour Capacity. The number of watt - hours which can be delivered by a cell or battery under specified conditions as to temperature, rate of discharge and final voltage.

Watthour Efficiency. (Energy Efficiency). The ratio of the watthours output to the watthours of the recharge.

Wet. Indication that the liquid electrolyte in a cell is free-flowing.

Wet charged stand. Period of time that a wet secondary cell can stand in charged condition without losing a specified small percentage of its capacity.

Wet Shelf life. Period of time that a wet secondary cell can stand in discharged condition before deteriorating to a point where it cannot be recharge.

APPENDIX I

Federal Specification.
Sulphuric Acid, Electrolyte. O - S - 801
(for Storage Batteries).

1. Scope and Classification.

1.1 Scope ..... This specification covers sulphuric acid for use in electrolyte solution for Storage batteries.

1.2 Classification.

1.2.1 Classes .... Sulphuric acid for storage batteries furnished under this specification shall be of the following classes, as specified.

Class 1. ..... Concentrated sulphuric acid, specific gravity 1.828 at 26.7°C (80°F)

Class 2. ..... Diluted sulphuric acid, specific gravity 1.395 plus or minus 0.005 at 26.7°C (80°F)

2. Requirements.

2.1 Material ..... The material shall be nonfuming sulphuric acid, suitable for electrolyte in storage batteries. The acid shall be substantially free of sediment, and shall meet the requirements specified herein after.

2.1.1 Color ..... The acid shall preferable colourless, but in no case shall its color be darker than that of the standard color solution, when tested.

2.1.2 Specific Gravity..... When measured with a hydrometer graduated in degrees Baume, the following values being equivalent:

Class 1, 65.7°B equals 1.828 specific gravity, 80°F

Class 2, 41.0°B equals 1.395 specific gravity, 80°F

2.1.3 Purity

2.1.3.1 Strength of acid ..... The H_2SO_4 content, by weight of the acid, shall be as follows:

Class 1 ..... Not less than 93.2 (93.19) percent.

Class 2 ..... 49.5 to 50.5 percent.

TABLE 8

Limits of Impurities in the Acid.

Item	Calculated as	Maximum limits percent.	
		Class 1	Class 2
Organic matter		(1)	(1)
Fixed residue		0.03	0.015
Iron	Fe	.005	.003
Sulfurous acid	SO_2	.004	.002
Arsenic	As	.0001	.00005
Antimony	Sb	.0001	.00005
Manganese	Mn	.00002	.00001
Nitrates	NO_3	.0005	.0003
Ammonium	NH_4	.001	.0005
Chloride	Cl	.001	.0005
Copper	Cu	.005	.003
Zinc	Zn	.004	.002
Selenium	Se	.002	.001
Platinum	Pt	(1)	(1)
Nickel	Ni	0.0001	0.00005

(1) To pass test.

Indian Standard.

Specification for Sulphuric Acid.

I.S. : 266 - 1961

There shall be four grades of the material, namely technical, battery, pure, and analytical reagent.

The battery grade acid shall have two sub - grades, namely concentrated and dilute.

Description.

Technical Grade. Sulphuric acid of technical grade shall be a liquid not darker than brown in colour.

Battery Grade. (Concentrated and Dilute). Sulphuric acid of battery grade shall be a colourless liquid. The concentrated acid on dilution with an equal volume of distilled water, and the dilute acid as received, shall be free from suspended matter and other visible impurities.

Pure and Analytical Reagent Grades. Sulphuric acid of pure and analytical reagent grades shall be a clear and colourless liquid, free from suspended matter and other visible impurities.

TABLE 9

Requirements for Sulphuric Acid.

No.	Characteristic	Requirement for Grade.				
		Tecnni-cal	Battery		Pure	Analytical. Reagent
			concentrated	Dilute		
1.	Specific gravity at 25°/25°C, min.	1.834	1.834	1.216	1.834	1.836
2.	Sulphuric acid (as H_2SO_4) percent by weight, min	95.0	95.0	29.7	95.0	96.0
3.	Residue on ignition, percent by weight, max.	0.2	0.06	0.02	0.01	0.0025
4.	Iron (as Fe) percent by wt., max.	0.05	0.002	0.0006	0.001	0.0001
5.	Chlorides (as Cl) percent by weight, max.	-	0.001	0.0003	0.0035	0.0003
6.	Heavy metals (as Pb), percent by weight, max.	0.005	-	-	0.002	0.0002
7.	Arsenic (as As_2O_3), percent by weight, max.	0.01	0.0003	0.0001	0.0005	0.00001
8.	Oxidizable impurities as SO_2	-	To pass test	To pass test	0.004 percent by wt. max.	0.0005 percent by wt. max.
9.	Organic matter	-	To pass test	-	-	-
10.	Nitrates (as NO_3) percent by weight, max.	-	-	-	-	0.00002

No.	Characteristic	Requirement for Grade				
		Technical	Battery		Pure	Analytical Reagent
			concentrated	Dilute		
11.	Ammonia (as NH_3), percent by weight, max.	-	-	-	-	0.0005
12.	Selenium (as Se), percent by weight, max.	-	0.002	0.0006	-	-
13.	Manganese (as Mn), percent by weight, max.	-	0.0001	0.00003	-	-
14.	Copper (as Cu), percent by weight, max.	-	0.003	0.001	-	-
15.	Zinc (as Zn), percent by weight, max.	-	0.003	0.001	-	-
16.	Nitrates, nitrites and ammonia, (as N), percent by weight, max.	-	0.003	0.001	0.003	-

Care in handling acid.

Men engaged in handling acid or electrolyte shall wear rubber aprons, rubber boots, and rubber gloves, so that the acid cannot come in contact with clothing or skin. The eye must be guarded by goggles. At any temperature the addition of even a small quantity of water to a carboy of strong acid may cause an explosion owing to the sudden evolution of heat. Therefore, carboys of acid must be kept securely stoppered.

Treatment of acid or electrolyte burns.

Burn caused by acid or electrolyte should be treated as follows:

a. First attention should be given to possible presence of the acid in the eye. If present, a thick paste of bicarbonate of soda (baking soda) should be applied immediately to the affected part. The soda should then be gently flushed out with large amounts of water, directed into the pocket formed by downward pressure on the skin below the eye. The procedure should be repeated until it is certain that all traces of the acid have been removed.

b. After the eyes are attended to, immediately sprinkle bicarbonate of soda on the exposed, affected skin surfaces. Then quickly remove any clothing that may have been spattered with the acid solution and apply bicarbonate of soda powder to affected skin areas not previously treated. Finally gently flush the powder off the skin with large amounts of water and repeat the procedure until it is certain that all affected parts have been well bathed.

c. Send for proper medical attention without delay.

d. When bicarbonate of soda is not available, large amounts of water may be used for flushing affected areas. It is extremely important that only large amounts of water be used. A small quantity of water is ineffective and its use may lead to greater damage than none at all.

Dope Electrolyte or Battive Additives.

Periodically much publicity is given to special additives for car and motor - vehicle batteries. Spectacular and extravagant claim are made for these additives for extending battery life or reviving old and ailing batteries. Treatment usually consists in adding the patent " elixir " to each cell of the battery followed by a long charge at about half the normal charging rate. The benefical effects of this treatment on batteries which have become discharged or sluggish in service are frequently immediate and noticeable when the battery is put back on the car and the starter motor operated. But similar results can be achieved by simply giving a long charge without adding " dope " to the battery. The large battery manufacturers spend vast sums of money in research for materials or methods of manufacture which will extend battery life or improve performance, but so far no electrolyte additive of any great merit has been invented. It is also of interest to note that most battery makers declare their guarantees void if anything other than pure water or sulphuric acid is added to batteries of their manufacture.

TABLE. 10

Three Grades of Pig Lead, according to

The Standard of the American Society for Testing.

Materials.

	1. Corroding Lead, %	2. Chemical Lead, %	3. Common. Lead, %
Silver, max. (1,3)	0.001 5	0.020 max. 0.002 min.	0.002
Copper, max. (1,3)	0.001 5	0.080 max 0.040 min.	
Copper and Silver to gether, max.	0.002 5	———	———
Arsenic, max.	0.001 5	———	———
Antimony and Tin together, max.	0.009 5	———	———
Antimony, arsenic and Tin together, max.	———	0.002	0.015
Zinc, max.	0.001 5	0.001	0.002
Bismuth, max.	0.05	0.005	0.15
Iron, max.	0.002	0.001 5	0.002
Lead (by difference) min.	99.94	99.90	99.85

Note. In No.1 bismuth, copper, and tin must not all be present in maximum amounts in the same sample.

No.2 is sometimes known as "Undesilverized Lead" from southeast Missouri ores.

The A.S.T.M. Specification includes four other types No.3 Acid lead, No.4 Copper lead, No.5 Common desilverized A No. 6 Common desiliverized B. and No.7 Soft Undesilverized.

Properties of Lead Oxides.

A high state of purity of the oxides used in the manufacture of storage batteries is required. The limiting percentages of impurities for both litharge and the red lead are both the same. A good grade of the oxides for storage - battery purposes would have about the amounts of impurities tabulated.

Table 11. Limits of Impurities in Lead Oxides.

Impurities	Per Cent Not to Exceed.
Antimony	0.002
Arsenic	0.000 05
Bismuth	0.05
Cadmium	0.003
Copper	0.003
Iron	0.02
Nickel	0.000 1
Silver	0.003
Thallium	0.001
Zinc	0.002
Manganese	0.000 03

WATER FOR USE IN SECONDARY BATTERIES.

(For Lead Acid Batteries of the Enclosed Cell Type)

This specification applies to water intended for use as a constituent of the electrolyte for enclosed cell, lead acid secondary batteries.

Appearance. The water shall be clear and free from suspended matter, odour and taste. When viewed vertically through a 100 - ml. Nessler tube the water shall be colourless.

Impurities. When determined, the amount of each impurity listed shall not exceed the following :

TABLE 12

Limits of Impurities in Water for use in Secondary Batteries.

Impurity	Limit	
	percent	p.p.m.
Residue on Evaporation	0.05	500
Volatile and Organic Matter.	0.015	150
Calcium and Magnesium	No limit specified.	
Nitrogen	0.005	50
Chlorine	0.005	50
Copper	0.000 5	5
Iron	0.000 5	5
Zinc	No limit specified.	

APPENDIX 2.

Maintenance.

Acid Levels.

Check the acid levels periodically, about once a fortnight or every 500 miles, and add pure water as necessary. Never add acid.

Care should be taken not to excees the normal level, which is usually about $\frac{1}{4}$ in. above the tops of the separators. If a battery is over filled there is a danger of the acid over flowing through the vent plugs when the battery is charged. Acid from the battery will attack hold - downs and other metal parts in its vicinity.

Corrosion.

Corrosion is due to the action of acid on metallic parts such as terminals and hold - downs. It can be prevented by keeping the top of the battery clean and dry, and protecting metal surfaces jelly. Whenever acid has been split the affected areas should be immediately wiped with a rag soaked in ammonia. If corrosion has already occured the areas should be cleaned by scraping, washing and drying, and protected by applying a coating of petroleum jelly.

In cases of poor starting, check for terminal corrosion and tightness of terminal connexions, as high - resistance connexions in the battery circuit often stem from corroded or loose - fitting terminals.

Laying Batteries.

When not in use, a battery loses some of its charge by internal chemical action, and this loss of charge is increased by high temperatures or external leakage currents if the battery top is wet and dirty. Batteries which remain long in a low state of charge become sulphated beyond the stage where they can be restored by recharging. The following procedure should be followed to maintain batteries healthy during laying - up periods :-

1. Disconnect the battery from the electrical system of the vehicle

2. Check the acid levels,and add pure water as necessary to restore levels which are low.

3. Give the battery a full recharge as under " Bench charging "

4. Clean and dry the battery top and terminal posts.

5. Recharge fully at least every two months and immediately before putting into service.

BENCH CHARGING.

Any charge given to the battery off the car or vehicle is referred to as a bench charge. This is usually necessary when the battery has been abused in some way such as prolong parking with the lights on, faults in the electrical system, or in-adequate charging in service. To be suitable for bench charging, a charger should have an output of several amperes, and usually a rating in amperes equal to about 5 percent of the battery capacity is suitable for most batteries.

A charge for a single night, or about 15 hr, should be sufficient to restore the battery to a substantially charged condition.

SAFETY.

Never bring a flame, or lighted cigarette or pipe near the battery during or shortly after a charge, as the gases generated on charge are a mixture of hydrogen and oxygen. The danger of an explosion is very remote under normal circumstances, and the risk is reduced if the

cell vent plugs are tightly in position.

Care should be taken to see that the vent holes do not become blocked with dirt or grease.

Change in Voltage.

Whilst improvements to the battery design were taking place, other changes affecting the voltage of the electrical system were also made. Up to about 1930 most car manufacturers in England and America were using 6-V systems. It was about this time that manufacturers in England started to adopt 12-V systems using 6-cell lead-acid batteries, and by the late 1940 this system was the standard for England. In America however, no great change from 6-V to 12-V batteries occured until 1953 - 54, when most U.S. motor manufacturers adopted 12-V systems. The main points in favour of the 12-V system are listed below.

1. For the same power requirements (volts multiplied by amperes) the current demand on the 12-V system is almost halved. This is an important reduction of the heavy current drain on the battery during engine starting.

2. Because of economy of current with the 12-V system, voltage drops (amperes multiplied by ohms) in cables and brushes of the statter motor are much lower and the cable size can be reduced.

3. Distributors and voltage regulators are more efficient at the higher voltage because of the reduced current which they have to make and break.

4. The 12-V generator can be smaller compared with the 6-V generator for the same output.

5. Any deterioration in battery condition, even if confined to one cell, can more readily be tolerated in a 6-cell than a 3-cell battery.

6. The 12-V battery is usually more expensive and heavier than the 6-V battery, but for the reason given in the last paragraph, the life of the 12-V battery should be longer than that of the 6-V battery.

Choice of Earthed Polarity.

Ever since batteries have been used on motor vehicle there has been a divergence of opinion regarding the earthing, or grounding, of the electrical system. In America and England both positive and negative earthing have been used at some time or other for motor - vehicle electrical systems. In America, most car manufacturers were earthing the positive pole of the battery to the car chasis until the advent of the 12-V battery about 1953, when there was a complete change to negative pole earthing. British manufacturers were divided between positive and negative earthing until about 1940, when positive earthing became standard practice.

Which-ever pole of the battery is earthed the electrical accessories use single - pole witing with one terminal of the battery and one side of all other electrical components securely connected to the chasis. The chasis therefore acts as an " earth " or return path for the electric circuit. The advantages claimed for the respective earthing systems are worth noting:-

a) Less corrosion of the battery terminal connectors is a claim made for both systems.

b) With positive earthing, ignition is better.

c) With positive earthing, burning or pitting of the electrodes of the plugs and distributer arm is less.

With regard to (a), it is a fact that corrosion of battery terminal cable connectors, which are usually lead - plated brass, will occur in the presence of sulphuric acid with either positive or negative errthing unless attention is given to cleaning them periodically and applying a protective coating of petroleum jelly against electrolytic attack.

Although it is generally agreed that the space between the plug points is more readily ionized and therefore a better conducting path for a spark when the contral electrode is made negative (as in positive earthing), the same result can be achieved with negative earthing by reversing the connexions to the coil. It would therefore appear that there

are no outstanding advantages which would make either choice greatly superior to the other.

Principle of Auto - fil Device.

The principle of the automatic topping - up device is shown in Fig. 10 The device relies on a ball valve which is closed during the topping - up operation. When topping - up, the top cover is removed, and water which is poured into the trough in the lid passed down each filling tube. An air lock is created inside the cell when the level reaches the bottom of the filling tube. The level within the cell can rise no further and the tube fills with water.

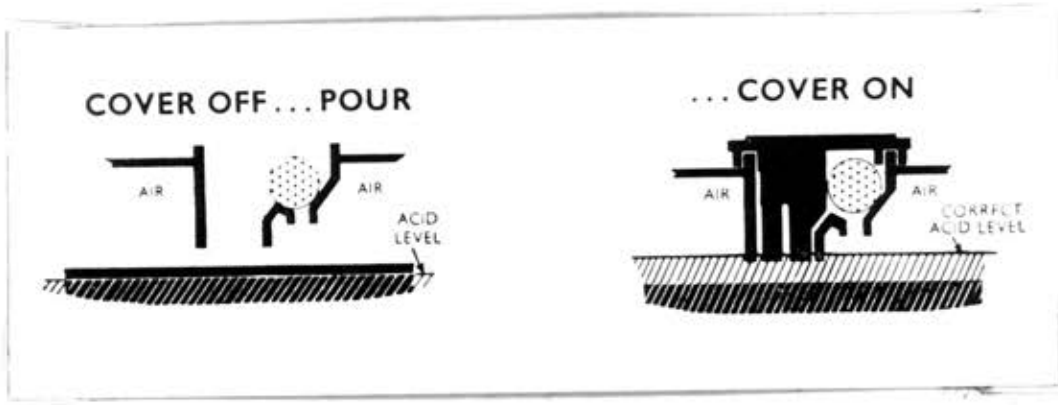


Fig. 10 Principle of Auto-Fil Device.

When the top cover is snapped back into position the plastic tubes on the underside of the cover displace the balls from the valve seats and the air lock is broken inside the cell. This allows the water in and around the tops of the filling tubes to pass into the cell. The complete operation ensures a speedy and accurate method of topping - up.

Silicon Controlled Rectifiers.

This latest development in the control of charging current by means of silicon controlled rectifiers is most interesting. The basic circuit is shown in Fig ..11.. The bridge - connected rectifier has two arms containing standard silicon rectifiers, and two containing silicon controlled rectifiers.

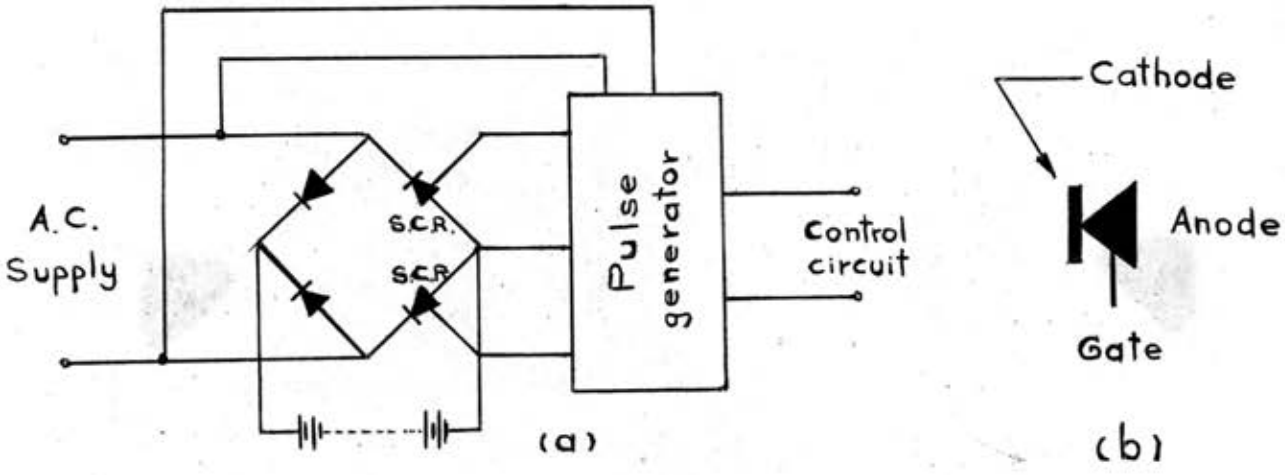


Fig. 11 Silicon Controlled Rectifier Charging.

a) Basic circuit.

b) Graphical symbol for silicon controlled rectifier (S.C.R.)

Either of the silicon controlled rectifier (S.C.R.) oppose the flow of current in both directions until a low - power input signal is fed into the control electrode, or gate. It then behaves like a normal rectifier and passes current for, say, the forward half-cycle. During the reverse half-cycle the second silicon controlled rectifier is "fired" and allows current to pass.

As in the grid control of mercury arc rectifiers, the mean charging current passing into a battery may be varied by controlling the instant in every half-cycle at which the silicon controlled rectifier is " fired "

Standards for Motor Vehicle Batteries.

For Many years the automobile industries in most countries have applied the principles of standardization to their products in the interests of efficiency and economy.

In America, the Society of Automotive Engineers (S.A.E.) has also published standards for lead - acid batteries used in motor vehicles, and recently the scope of the standards issued in Great Britain by the Society of Motor Manufacturers & Traders (S.M.M.T.) also has been extended to include batteries. Six tests are listed which must be met before a battery can be accepted as having the required quality and performance. These are :-

1. Rating Test at the 20-hr rate at $77^{\circ}F$ ($25^{\circ}C$)
2. High - rate discharge test at 77 F ($25^{\circ}C$)
3. High - rate discharge test at $0^{\circ}F$ ($-18^{\circ}C$)
4. Test for retention of charge.
5. Life cycling Test.
6. Overcharge Test.

For laboratory Tests to have any practical value or significance they should simulate, as closely as possible, actual service conditions. This is not easy to accomplish as no two batteries in service, even on similar car, will do exactly the same work.

Some cars will cover about 500 miles or more each week with long runs, resulting in the battery always being fully charged, and possibly overcharged. Other cars may cover as little as 100 to 200 miles each week with short run, frequent stops and starts, and in-sufficient running to maintain the battery fully charged. The majority of car owners will possibly cover a weekly mileage some-where between these two ranges with batteries maintained generally in a substantially charged condition.

Test in the laboratory are therefore something of a compromise of the conditions likely to be experienced in service.

The 20 - hr capacity test (No.1) has no great practical significance, although useful in proving the battery as regards the amouts of active materials and volume of acid provided.

The two test at engine - starting rates of discharge (No.2 and 3) are most valuable in proving that the battery is capable of providing power for starting for a considerable period. A battery which satisfied test No.2, at normal temperature, would be capable of supplying at least 70 engine starts each of 5 sec. duration taken consectively without any charge between starts. Similarly, a battery satisfying the test conditions at $0^{\circ}F.$(No.3) would be capable of supplying at least 36 starts each of 5 sec. before the battery became discharged. The smaller number of starts at $0^{\circ}F.$ ($-18^{\circ}C$)compared with $77^{\circ}F$($25^{\circ}C$) demonstrates the loss of capacity which occur when a battery is cooled. This loss of capacity lasts only while the battery is cold, and capacity is completely restored when the battery temperature is raised to normal. The low temp - erature starting test is one of the most exacting of battery tests,and is particularly useful in assessing battery quality.

The test for charge retention (No.4) when the battery is new proves that the materials used in the battery meet the desirable standards of purities. Impurities in the lead of the grids or paste oxides, or in the sulphuric acid, would increase the loss of charge due to internal chemical action with the battery idle. All lead - acid batteries lose some capacity on standing, and as the loss increases as a battery ages, it is essential that it be kept to a minimum when the battery is new.

A battery in service on a car is alternately discharged and charged. In the winter the demands on the battery are greatly increased, (not in tropical climate) resulting in its stabilizing in a partly discharged condition; in the summer the reverse holds, and battery tends to be overcharged. The combined effect of winter and summer running conditions is to produce some discharging and overcharging. It is impossible to reproduce exactly these conditions in one laboratory test, and the best compromise is to conduct two life tests.

One of these is the life cycle test (No.5), when the battery is taken through a fairly deep discharge followed by a generous recharge on each cycle. This test is most useful in proving the quality of the positive and negative active materials (pastes). Batteries not coming up to the desired standard fail this life test or deterioration (sulphation) of the negative paste, or a combination of both.

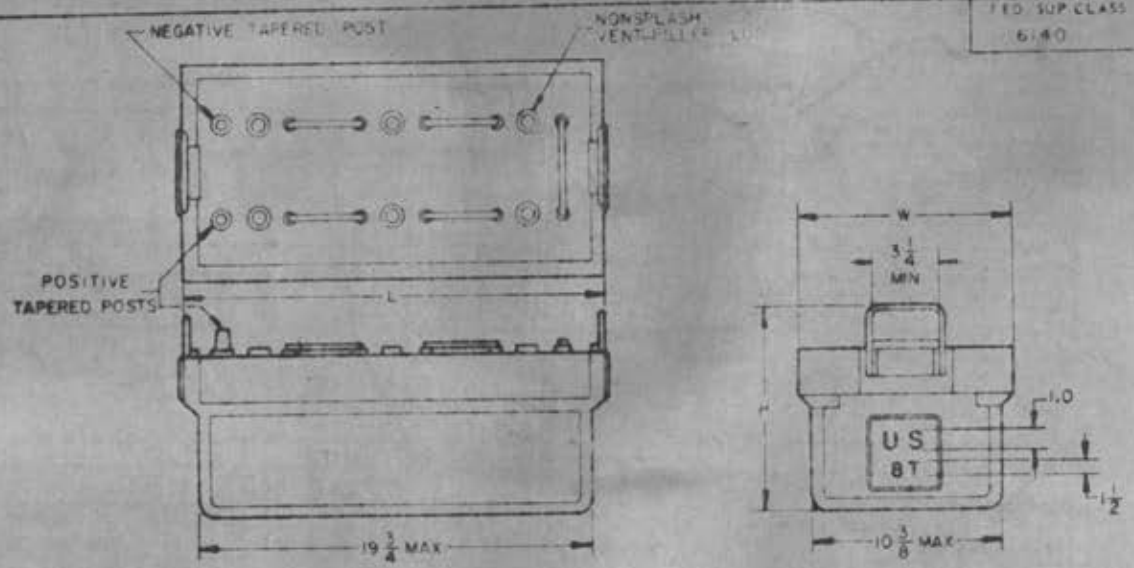
The second life test (No.6) is one when the battery is given repeated charges at fairly high temperatures, in an endeavour to reproduce the effects of the prolonged charging to which most batteries are subjected in service. The test is most useful in proving the corrosion resistance of the positive grid, and batteries which fail show premature collapse of the positive grid frame.

A battery which failed the life cycle test (No.5) would not necessarily have a short life in service. On the other hand a battery which failed the overcharge test (No.6) would almost certainly have a short life. A grid alloy which resists anodic corrosion is therefore one of the most essential features for longevity of automotive batteries.

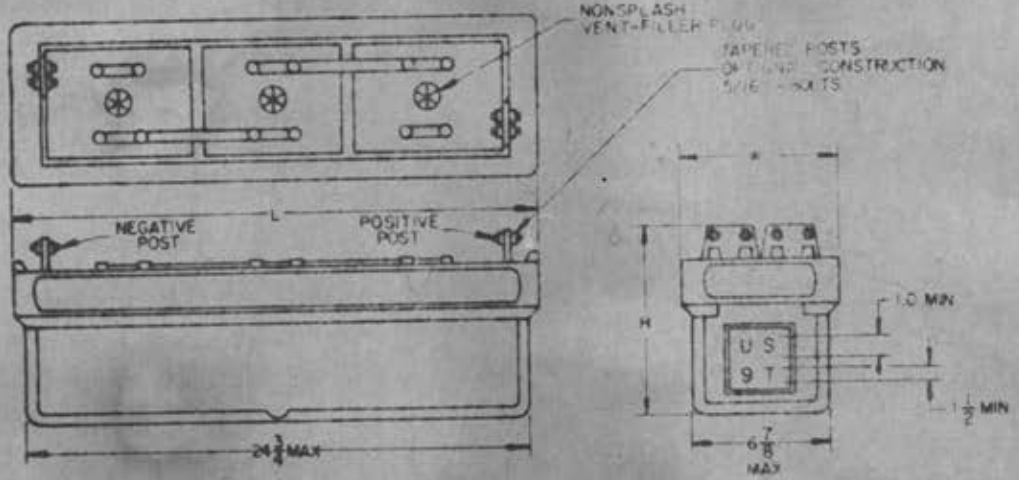
" Gyp " (cheap) batteries, as supplied mainly for the replacement market, would almost certainly fail most of the above tests. Large manufacturers who supply the initial equipment batteries maintain the same high standards for their replacement batteries.

FED. SUP. CLASS 6140

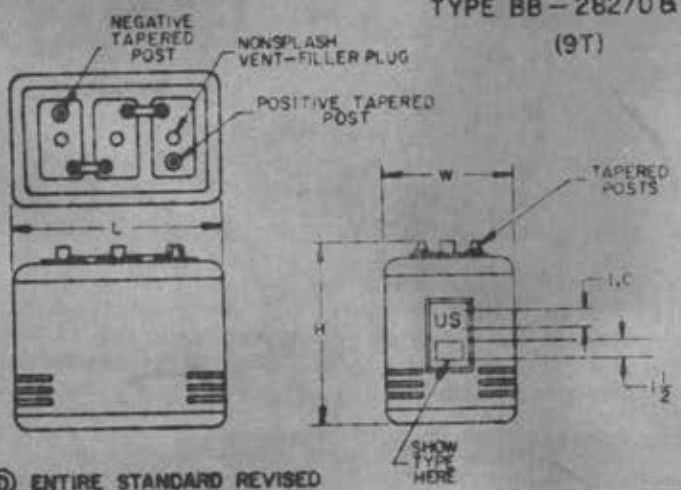
REVIEWERS: ARMY-EL., NAVY-DOCKS, AF-ROAMA
USERS: ARMY-GL., NAVY-MC, SHIPS, WEPS



TYPE BB-223/U (8T)



TYPE BB-282/UB( )
(9T)



TYPE BB-221/U (2H)
TYPE BB-55 (4H)
TYPE BB-57 (7H)

Ⓓ INACTIVE FOR NEW DESIGN AFTER 11 JUNE 1964 USE MS 35000

Ⓓ ENTIRE STANDARD REVISED

APPROVED 27 FEBRUARY 1963 REVISED Ⓓ 11 JUNE 1964

P.A. MO(ATAC) Other Cust Navy – Docks AF – ROAMA	TITLE BATTERY, STORAGE, LEAD-ACID, NON-WATERPROOF	MILITARY STANDARD MS 35001
PROCUREMENT SPECIFICATION MIL-B-11188	SUPERSEDES	SHEET 1 OF 2

DD FORM 672-1

FED. SUP. CLASS 6140

REVIEWERS: ARMY-EL; NAVY-DOCKS; AF-ROAMA
USERS: ARMY-GL; NAVY-MC, SHIPS, WEPS

BATTERY DIMENSIONS										
TYPE NUMBER	LENGTH (L) INCHES				WIDTH (W) INCHES		HEIGHT (H) INCHES			
	WITH HANDLES		WITHOUT HANDLES				WITH HANDLES		WITHOUT HANDLES	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
BB-221/U (2H)			10-3/8	10-3/16	7-1/8	7			9-3/8	9-1/16
BB-55 (4H)			13-3/8	12-5/8	7-1/8	7			9-3/8	9-1/16
BB-223/U (8T)	21-1/8	20-7/8	20-1/2	20-1/4	11	10-13/16	10-9/16	10-7/16	9-3/4	9-1/2
BB-282/U&( ) (9T)			25-1/2	25-1/4	7-1/2	7-3/8			11-9/16	10-7/8
BB-57 (7H)			16-1/4	16	7-1/8	6-7/8			9-3/8	9-1/8

PHYSICAL AND ELECTRICAL REQUIREMENTS					
	BB-221/U (2H)	BB-55 (4H)	BB-223/U (8T)	BB-282/U&( ) (9T)	BB-57 (7H)
PART NUMBER					
CHARGED AND DRY	MS 35001-1	MS 35001-3	MS 35001-5	MS 35001-7	MS 35001-9
CHARGED AND WET	MS 35001-2	MS 35001-4	MS 35001-6	MS 35001-8	MS 35001-10
CLASS	FE	FE	FE	FE	FE
WEIGHT (UNFILLED)	38 POUNDS	50 POUNDS	125 POUNDS	118 POUNDS	67 POUNDS
WEIGHT (FILLED)	48 POUNDS	63 POUNDS	165 POUNDS	148 POUNDS	85 POUNDS
NOMINAL VOLTAGE	6 VOLTS	6 VOLTS	12 VOLTS	6 VOLTS	6 VOLTS
FINAL VOLTAGE AT 20 HOUR RATE	5.25 VOLTS	5.25 VOLTS	10.5 VOLTS	5.25 VOLTS	5.25 VOLTS
RATED CAPACITY AT 20 HOUR RATE	120 AMP-HOURS	156 AMP-HOURS	200 AMP-HOURS	355 AMP-HOURS	200 AMP-HOURS
DISCHARGE AT 20-HOUR RATE	6 AMPERES	7.5 AMPERES	10 AMPERES	16.75 AMPERES	10 AMPS
CHARGING RATE	6 AMPERES	8 AMPERES	10 AMPERES	17 AMPERES	18 AMPS

QUALIFICATION AND QUALITY CONFORMANCE INSPECTIONS					
TEST	MINIMUM VALUES				
	BB-221/U (2H)	BB-55 (4H)	BB-223/U (8T)	BB-282/U&( ) (9T)	BB-57 (7H)
FILLED DISCHARGE AT 80°F					
TIME TO DROP TO 1 VOLT PER CELL	8 MINUTES	9 MINUTES	14 MINUTES	25 MINUTES	14 MINUTES
FULL CHARGE CAPACITY AT 80°F	120 AMP-HRS	155 AMP-HRS	200 AMP-HRS	335 AMP-HRS	200 AMP-HRS
HIGH DISCHARGE RATE (300 AMPS) AT MINUS 40°F. Time to drop 1 volt per cell					
MINIMUM 5 SECOND VOLTAGE	2.25 MINUTES	3 MINUTES	4 MINUTES	7 MINUTES	4 MINUTES
LOW TEMP PERFORMANCE / MINUS 40°F	30 AMP-HRS	38 AMP-HRS	50 AMP-HRS	83 AMP-HRS	50 AMP-HRS
LIFE CYCLE CAPACITY TEST 1	236 CYCLES	300 CYCLES	404 CYCLES	488 CYCLES	538 CYCLES
OVERCHARGE CYCLE TEST	11 CYCLES	15 CYCLES	25 CYCLES	31 CYCLES	20 CYCLES
RETENTION OF CHARGE	96 AMP-HRS	120 AMP-HRS	160 AMP-HRS	268 AMP-HRS	160 AMP-HRS

NOTES:
1. FOR CHARGED AND DRY BATTERIES (MS 35001-1, -3, -5, -7 & -9), ELECTROLYTE NOT FURNISHED.
2. FOR CHARGED AND WET BATTERIES (MS 35001-2, -4, -6, -8 & -10), TO BE FILLED WITH ELECTROLYTE AND READY TO USE.
3. INTER-CELL CONNECTOR STRAPS SHALL BE COVERED BY SEALING COMPOUND.
4. UNLESS OTHERWISE SPECIFIED, TYPE 8T BATTERIES ARE FURNISHED WITH HANDLES. ALL TYPE 8T BATTERIES FOR SPARE PARTS ARE TO BE FURNISHED WITH HANDLES.
5. UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERANCES ARE ± 1/16 ON FRACTIONS.
6. THE MS PART NUMBER CONSISTS OF THE MS MILITARY STANDARD NUMBER FOLLOWED BY A DASH NUMBER.
7. REFERENCED DOCUMENTS SHALL BE OF THE ISSUE IN EFFECT ON DATE OF INVITATIONS FOR BID.
8. FOR DESIGN FEATURE PURPOSES, THIS STANDARD TAKES PRECEDENCE OVER PROCUREMENT DOCUMENTS REFERENCED HEREIN.
9. THIS STANDARD IS NOT INTENDED TO LIMIT CONSTRUCTION TO FEATURES OTHER THAN AS SHOWN HEREON BY DIMENSIONS, NOTATIONS OR REFERENCED DOCUMENTS.

APPROVED 27 FEBRUARY 1953 REVISED (D) 11 JUNE 1964

P.A. MO(ATAC)	TITLE	MILITARY STANDARD
Other Cust	BATTERY, STORAGE, LEAD-ACID, NON-WATERPROOF	MS 35001
Navy-Docks		
AF-ROAMA		
PROCUREMENT SPECIFICATION MIL-B-11188	SUPERSEDES	SHEET 2

DD FORM 1 SEP 57 672-1

POWER BATTERIES FOR MILITARY VEHICLES

(DRY CHARGED)

Type	Volt	Number of Plates per cell	Capacity @ 20-hr Rate (Ah)	Maximum Dimensions (Container) (mm.)		
				Length	Width	Height
2 H	6	17	120	253	175	210
4 H	6	23	150	313	175	210
4 D	12	23	150	513	222	211
8 D (8T)	12	29	200	533	278	216

Specification of Power Battery.

Type 2H, 4H, 4D and 8D

Military Code	Type		Capacity at 20Hr-rate (ampere-hour)	weight of pos.pl.neg. pl. and separators (kgs.	weight of container, cell lids and vent plugs(kgs)	weight of unfilled battery (kgs.)	weight of filled battery (kgs.) *	Remark.
	volts	plate						
2H	6	17	120	13.22	4.15	18.70	23.50	1.000 1/cell
4H	6	23	150	16.46	3.68	21.80	28.30	1.700 1/cell
4D	12	29	150	32.70	12.00	47.00	59.5	1.700 1/cell
8D	12	29	200	41.19	10.00	56.70	73.70	2.200 1/cell

* Filled with sulphuric acid sp.gr. 1.280 at 30°C.

Bibliography.

American Standard for Storage Batteries (Revised). AIEE No.36
Published by The American Institute of Electrical Engineers
33 West Thirty - ninth Street,
New York 18, N.Y.

Electrochemical Engineering (Fourth Edition)
by C.L. Mantell, Ph.D.
Mc GRAW - HILL Book Company, INC.

Indian Standard
I.S: 266 - 1961 Specification for Sulphuric Acid (Revised).
I.S: 395 - 1962 Specification for Lead - Acid Storage Batteries (Light Duty) for Motor Vehicles (Second Revision)
I.S: 985 - 1962 Specification for Lead - Acid Storage Batteries (Heavy Duty) for Motor Vehicles (Revised)

Indian Standards Institution
Manak Bhavan, 9 Mathura Road.
New Delhi 1.

Industrial Electrochemical (Third Edition).
By C.L. Mantell, Ph.D.
(Chemical Engineering Series).
Mc GRAW - HILL Book Company, INC.

Instruction of Bascule Equipments.
by Fuji Car Manufacturing Co., Ltd.

Principles and Applications of Electrochemistry (Second Edition)
Volume 2 - Applications
by W.A. KOEHLER.
John Wiley & Sons, INC.

Standards Association of Australia
Australian Standard Specifications for
WATER FOR USE IN SECONDARY BATTERIES.
(for lead acid batteries of the endosed cell type)
AS No. C.59 - 1961 and
SULPHURIC ACID FOR USE IN SECONDARY BATTERIES.
AS. No. C.60 - 1961

Storage Battery Technical Service Manual.
(Revised fifth edition).
Published by The Association of American Battery Manufacturers.

Storage Batteries.
Including operation, charging, maintenance and repair
by G. Smith, A.M.I.E.E.
Assistance Engineering Manager Chloride Batteries Ltd.
SIR ISAAC PITMAN & SONS LTD.

Storage Batteries (Fourth Edition). ✳
A general treatise on the physics and chemistry of secondary batteries and their engineering applications.
by George Wood Vinal, Sc.D.
New York. John Wiley & sons, INC.
London. Chapman & Hall, Ltd.

Type 2H

Current 6 Amps.

No.of Discharge 2

Battery No. M-1

Remarks

6Y17PL.

Rated Capacity at 20Hr-rate 120Ah.

Discharge at 20Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
open	cht.	6.53	218	227	10			34.5	
			217	228	11	1.279	90		
			218	229	11				
Start		6.45							6
	5	6.30							6
	15	6.30							6
	30	6.30							6
1	00	6.30	210	218	08			34.0	6
			211	219	09	1.274	90		
			210	220	10				
2	00	6.30	210	220	12			34.0	6
			210	222	12	1274	90		
			210	222	12				
3	00	6.24	208	220	10			32.0	6
			208	218	12	1.264	90		
			208	220	12				
4	00	6.24	208	219	11			31.0	6
			208	220	12	1.254	90		
			208	220	12				

Battery Organization. Bangna.

Type ...2 H.....

Current ...6..... Amps.

No.of ...Discharge ...2.....

Battery No. ...M-1.....

Remarks

6V17PL.

Rated Capacity at 20 Hr-rate 120 Ah

Discharge at 20 Hr-rate

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
5	00	6.18	206	215	09			30.0	6
			206	217	10	1.243	87		
			206	218	11				
6	00	6.15	205	214	09			30.0	6
			205	216	10	1.235	87		
			205	217	11				
7	00	6.13	204	215	12			29.0	6
			205	217	12	1.227	85		
			204	218	13				
8	00	6.12	204	216	13			29.0	6
			204	217	14	1.216	83		
			204	218	14				
9	00	6.12	204	214	12			29.5	6
			204	216	12	1.211	82		
			204	216	14				
10	00	6.06	202	214	12			29.5	6
			202	216	14	1.201	82		
			202	216	14				
11	00	6.03	201	212	12			29.0	6
			201	213	12	1190	80		
			201	214	14				

Battery Organization. Bangna.

Type ..... 2 H

Current ..... 6 ..... Amps.

No.of ..... Discharge 2 .....

Battery No. ..... M-1 .....

Remarks

6 V 17 PL.

Rated capacity at 20 Hr-rate 120 Ah.

Discharge at 20 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°c)	Amps.
H	M			Pos.	Neg.				
12	00	6.00	200	212	13			28.2	6
			200	214	14	1.175	80		
			200	214	14				
13	00	5.98	199	214	16			27.5	6
			200	215	16	1.171	83		
			199	215	16				
14	00	5.94	198	213	16			27.5	6
			198	214	17	1.165	80		
			198	214	16				
15	00	5.89	196	208	13			27.0	6
			197	210	14	1.150	80		
			196	210	14				
16	00	5.88	196	211	16			27.5	6
			196	212	16	1.135	84		
			196	212	16				
17	00	5.80	193	206	17			27.5	6
			194	208	16	1.125	80		
			193	210	17				
18	00	5.76	192	206	16			31.5	6
			193	208	16	1.100	80		
			191	208	17				

Battery Organization. Bangna.

Type ..2 H.....

Current ..6..... Amps.

No.of ..Discharge 2.....

Battery No. ..M-1.....

Remarks

6 V 17 PL.

Rated capacity at 20 Hr-rate 120 Ah.

Discharge at 20 Hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
19	00	5.64	190	205	16			32.5	6
			191	207	17	—	82		
			188	206	19				
19	30	5.63	184	204	16			34.0	6
			140	205	16	—	82		
			185	204	19				
19	45	5.62	188	205	18			34.2	6
			190	206	17	—	84		
			184	204	21				
20	00	5.45	187	203	17			35.0	6
			184	205	16	—	83		
			179	202	24				
20	15	5.35	186	204	18			35.0	6
			189	206	17	—	85		
			164	200	32				
Cut off voltage		5.25 V.	at 20.25 Hr.						

Battery Organization. Bangna.

Type ... A.H.....

Current ....7.5..... Amps.

No.of ....Discharge 2.....

Battery No. ..M-2.....

Remarks

6.V 23PL

Rated Capacity at 20 Hr. rate 150 Ah

Discharge at 20 Hr. rate

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
Open	ckt.	6.42	214	224	10			35.5	
			214	223	10	1.279	90		
			214	224	10				
-	Start	6.34							7.5
0	05.	6.26							7.5
0	15.	6.31							7.5
0	30	6.32							7.5
1	00	6.30	210	220	10			37.5	7.5
			210	219	10	1.269	90		
			210	220	10				
2	00	6.27.	209	219	10			34.5	7.5
			209	219	11	1.269	90		
			209	220	11				
3.	00	6.27.	209	218	10			32.0	7.5
			209	219	12	1257	85		
			209	218	12				
4.	00	6.28	207	216	09			31.0	7.5
			206	216	09	1.257	85		
			207	216	09				

Battery Organization. Bangna.

Type ...4.H.....

Current ....7.5..... Amps.

No.of ....Discharge 2.....

Battery No. ....N:2.....

Remarks

6V 23 PL

Rated Capacity at 20 Hr-rate 150 Ah

Discharge at 20 Hr-rate

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
8.	00	6.18	206	216	09			30.0	7.5
			206	216	10	1.232	85		
			206	217	11				
6.	00	6.16	206	215	10			29.0	7.5
			205	216	11	1.227	85		
			205	216	11				
7.	00	6.15	205	215	10			29.0	7.5
			205	215	11	1.224	85		
			205	216	11				
8	00	6.12	204	214	12			29.0	7.5
			204	216	13	1.205	80		
			204	218	14				
9.	00	6.09	203	214	12			28.0	7.5
			203	216	13	1.201	83		
			203	217	13				
10.	00	6.06	202	214	13			28.0	7.5
			202	216	14	1.200	80		
			202	216	14				
11	00	6.03	201	213	13			28.5	7.5
			201	214	13	1.175	84		
			201	216	15				

Battery Organization. Bangna.

Type ....A.H.....

Current ....7.5..... Amps.

No.of ....Discharge 2.....

Battery No. ..M-2.....

Remarks

6V 23 PL

Rated Capacity at 20Hr-rate 138 Ah

Discharge at 20 Hr-rate

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
12	00	6.00	200	212	13			28.0	7.5
			200	213	14	1.165	80		
			200	214	14				
13	00	5.94	198	213	15			27.8	7.5
			198	214	16	1155	80		
			198	214	16				
14	00	5.91	197	213	16			27.8	7.5
			197	213	16	1.145	80		
			197	214	16				
15	00	5.88	196	208	13			28.0	7.5
			196	210	14	1.135	80		
			196	211	15				
16	00	5.85	195	208	13			28.0	7.5
			195	210	16	1.120	80		
			195	210	16				
17	00	5.80	193	207	14			30.0	7.5
			192	209	16	1.105	80		
			193	210	16				
18	00	5.76	192	204	14			31.0	7.5
			192	207	16	—	82		
			192	208	17				

Battery Organization. Bangna.

Type ...4H.....

Current ...7.5..... Amps.

No.of ...Discharge 2.....

Battery No. ..M-2.....

Remarks

6V28PL

Rated Capacity at 20 Hr-rate 150 Ah

Discharge at 20 Hr-rate

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
19.	00	5.70	190	203	14			32.2	7.5
			190	204	15	—	83		
			190	204	16				
20	00	5.59	186	201	15			34.5	7.5
			187	203	16	—	83		
			186	203	18				
20	30	5.49	183	200	17			35.0	7.5
			184	202	19	—	85		
			182	202	20				
21	00	5.43	181	200	20			35.0	7.5
			182	203	22	—	85		
			180	202	23				
Cut	off	Voltage	5.25	at 21 Hr					

Battery Organization. Bangna.

Type A.D.

Current 7.5 Amps.

No.of Discharge 2

Battery No. N-5

Remarks

12 V 23 PL.

Rated Capacity at 20 Hr-rate 150 Ah.

Discharge at 20 Hr-rate

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
Open	ckt.	12.92	213	223	10			35.5	
			214	223	10	1279	90		
			214	223	10				
			214	224	10	1279	90		
			214	223	10				
			213	223	10				
Start		1260							7.5
-	05	12.54							7.5
-	15	12.58							7.5
-	30	12.58							7.5
1	00	12.58	209	219	10			37.5	7.5
			209	220	10	1269	90		
			210	220	10				
			210	220	10				
			210	220	10	1269	90		
			210	220	11				
2	00	12.54	209	219	10			34.5	7.5
			209	217	08	1264	90		
			209	220	11				
			209	220	11				
			209	220	12	1264	90		
			209	220	12				

Battery Organization. Bangna.

Type ..4.D.....

Current ...7.5..... Amps.

No.of ...Discharge 2.....

Battery No. ...M.S.....

Remarks

12 x 23 PL.

Rated Capacity at 20 Hr-rate 150Ah.

Discharge at 20 Hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
3	00	12.48	208	218	11			32.0	7.5
			208	220	12	1.257	85		
			208	220	12				
			208	220	12				
			208	220	12	1257	85		
			208	220	12				
4	00	1242	207	217	10			31.0	7.5
			207	217	10	1.252	85		
			207	217	10				
			207	217	10				
			207	218	10	1.252	85		
			207	218	10				
5	00	1242	207	218	12			30.0	7.5
			207	219	12	1248	85		
			207	218	13				
			207	219	12				
			207	220	13	1245	85		
			207	220	13				
6	00	1235	205	217	12			29.0	7.5
			206	217	12	1227	85		
			206	218	13				
			206	218	13				
			206	218	13	1227	85		
			206	218	13				

Type ...4 D.....

Current ...7.5..... Amps.

No.of ...Discharge 2.....

Battery No. ...M-5.....

Remarks

12 V 23 PL.

Rated Capacity at 20 Hr-rate 150 Ah.

Discharge at 20 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
7	00	1224	204	216	12			29.0	7.5
			204	216	12	1224	85		
			204	217	13				
			204	217	13				
			204	217	13	1224	85		
			204	217	14				
8	00	1224	204	218	14			29.0	7.5
			204	217	13	1205	80		
			204	218	14				
			204	218	14				
			204	218	14	1205	80		
			204	218	15				
9	00	12-18	203	216	14			28.0	7.5
			203	217	14	1201	83		
			203	218	14				
			203	218	14				
			203	218	14	1201	83		
			203	218	14				
10	00	1212	202	216	15			28.0	7.5
			202	216	14	1200	80		
			202	217	15				
			202	217	15				
			202	217	15	1200	80		
			202	217	15				

Battery Organization. Bangna.

Type .4.D.....

Current ...7.5..... Amps.

No.of ...Discharge 2.....

Battery No. ..M-5.....

Remarks

12 V 23 PL.

Rated Capacity at 20 Hr-rate 150 AH

Discharge at 20 Hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
11	00	12.06	201	215	15			28.5	7.5
			201	216	15	1175	80		
			201	217	16				
			201	217	16				
			201	217	16	1175	80		
			201	217	16				
12	00	12.00	200	213	14			28.0	7.5
			200	214	15	1165	80		
			200	215	16				
			200	215	16				
			200	215	16	1165	80		
			200	215	16				
13	00	11.88	198	214	16			27.3	7.5
			198	214	16	1155	80		
			198	214	16				
			198	215	17				
			198	215	17	1155	80		
			198	215	17				
14	00	11.82	197	212	16			27.2	7.5
			197	212	16	1145	80		
			197	213	17				
			197	214	17				
			197	214	17	1145	80		
			197	214	17				

Battery Organization. Banana.

Type 4 D

Current 7.5 Amps.

No.of Discharge 2

Battery No. M-5

Remarks

12 v 23 PL.

Rated Capacity at 20 Hr-rate 150Ah.

Discharge at 20 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
15	00	11.76	196	210	16			28.0	7.5
			196	212	16	1.135	80		
			196	213	18				
			196	213	18				
			196	214	18	1.135	80		
			196	214	18				
16	00	11.67	194	210	16			28.0	7.5
			195	211	16	1.120	80		
			194	211	17				
			193	212	18				
			195	212	18	1.120	80		
			194	212	19				
17	00	11.61	193	209	17			30.0	7.5
			194	210	18	1.110	80		
			193	211	19				
			194	212	19				
			194	211	18	1.110	80		
			193	211	19				
18	00	11.49	191	206	17			31.0	7.5
			192	209	18	1.096	82		
			191	210	19				
			192	209	18				
			192	210	19	1.096	82		
			191	210	20				

Battery Organization. Bangna.

Type ..4D.....

Current ..7.5..... Amps.

No.of ...Discharge...2.....

Battery No. ..M-5.....

Remarks

12 V. 23 PL.

Rated Capacity at 20 Hr-rate 150 Ah.

Discharge at 20 Hr-rate

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
19	00	11.37	189	205	17			32.2	7.5
			190	206	18	—	83		
			189	208	19				
			190	209	19				
			190	209	20	—	83		
			189	207	19				
20	00	11.20	186	204	19			34.5	7.5
			187	205	19	—	83		
			187	206	20				
			187	205	19				
			187	206	20	—	83		
			186	206	21				
20	30	10.98	182	202	21				
			183	203	20	—	85		
			183	205	23				
			184	204	21				
			184	205	21	—	85		
			182	204	23				
21	00	10.71	176	196	22			35.0	7.5
			179	200	22	—	85		
			178	201	25				
			181	201	22				
			180	203	23	—	85		
			177	201	26				
Cut off voltage 10.50 V.			at 21 Hr.						

Battery Organization. Bangna.

Type ...S.P.....

Current ...10.....Amps.

No. of ...Discharge...2.....

Battery No. ...M-6.....

Remarks

12 V 24 PL.

Rated Capacity at 20 Hr-rate 200 Ah.

Discharge at 20 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°c)	Amps.
H	M			Pos.	Neg.				
open	ckt.	13.02	217	227	10			34.5	
			217	227	11	1.274	90		
			217	227	11				
			217	227	11				
			217	227	11	1.274	90		
			217	227	11				
Start		12.60							10
	5	12.50							10
	15	12.50							10
	30	12.50							10
1	00	12.60	210	221	12			37.0	10
			210	221	12	1.264	90		
			210	221	12				
			210	222	12				
			210	222	12	1.264	90		
			210	222	12				
2	00	12.55	210	220	12			34.0	10
			210	222	12	1.264	90		
			210	222	12				
			208	220	12				
			209	221	12	1.264	90		
			208	223	12				

Battery Organization. Bangna.

Type ..9.0.....

Current ..10.....Amps.

No. of ..Discharge 2.....

Battery No. ..M.C.6.....

Remarks

12 v 29 PL.

Rated Capacity at 20 Hr-rate 200Ah.

Discharge at 20 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°c)	Amps.
H	M			Pos.	Neg.				
3	00	12.47	208	220	12			32.0	10
			208	220	12	1254	90		
			209	220	12				
			208	220	12				
			209	220	10	1254	90		
			208	220	12				
4	00	12.46	208	220	12			31.0	10
			207	220	13	1243	88		
			208	220	13				
			207	220	13				
			208	220	13	1243	88		
			208	220	13				
5	00	12.35	206	218	11			30.0	10
			205	218	12	1233	87		
			206	219	12				
			206	218	13				
			206	218	13	1233	87		
			206	218	13				
6	00	12.29	205	217	12			29.5	10
			204	217	14	1223	87		
			205	218	14				
			205	217	15				
			205	217	15	1223	87		
			205	217	15				

Type ...S.D.....

Current ...10.....Amps.

No. of ....Discharge...2.....

Battery No. ...M-G.....

Remarks

12 v 29 PL.

Rated Capacity at 20 Hr-rate 200 Ah.

Discharge at 20 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
7	00	12.25	205	218	14			29.0	10
			204	218	14	1.217	85		
			204	218	15				
			204	218	15				
			204	218	16	1.217	85		
			204	218	16				
8	00	12.18	203	216	14			29.0	10
			203	217	14	1.202	85		
			203	217	15				
			203	218	15				
			203	218	15	1.202	85		
			203	218	15				
9	00	12.16	203	217	14			29.0	10
			203	217	15	1.197	85		
			202	218	16				
			202	218	16				
			203	218	16	1.197	85		
			203	218	15				
10	00	12.12	202	216	14			29.5	10
			202	216	15	1.186	82		
			202	216	15				
			202	217	16				
			202	217	16	1.181	82		
			202	217	16				

Battery Organization. Bangna.

Type SD

Current 10 Amps.

No. of Discharge 2

Battery No. M-6

Remarks

12 V 24 PL.

Rated Capacity at 20 Hr-rate 200 Ah.

Discharge at 20 Hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
11	00	12.05	201	215	15			29.0	10
			209	215	16	1.176	82		
			209	215	16				
			200	215	16				
			200	216	16	1.171	82		
			200	216	16				
12	00	11.98	200	215	16			29.2	10
			200	215	16	1.266	82		
			200	216	16				
			199	216	17				
			199	216	16	1.261	82		
			200	216	16				
13	00	11.89	198	212	14			27.5	10
			198	212	14	1.156	83		
			198	213	15				
			198	214	16				
			198	214	16	1.156	83		
			198	214	16				
14	00	11.82	197	213	16			27.5	10
			197	212	16	1.145	80		
			197	212	16				
			197	213	16				
			197	212	17	1.140	80		
			197	213	17				

Battery Organization. Bangna.

Type ..P.D.....

Current ...10.....Amps.

No. of ...Discharge 2.....

Battery No. ...M-6.....

Remarks

12 V 29 PL

Rated Capacity at 20 Hr-rate 200 AH

Discharge at 20 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
15	00	11.71	196	211	16			27.0	10
			196	211	16	1135	80		
			196	211	16				
			197	211	17				
			196	211	16	1130	80		
			196	211	16				
16	00	11.68	195	211	17			27.5	10
			195	211	18	1125	80		
			196	211	18				
			194	211	18				
			194	211	17	1120	80		
			194	211	18				
17	00	11.52	192	207	18			31.5	10
			192	209	17	—	82		
			192	209	18				
			192	209	18				
			192	209	18	—	82		
			192	209	19				
18	00	11.40	190	208	18			31.5	10
			190	208	18	—	82		
			190	208	18				
			190	208	18				
			190	207	18	—	82		
			190	208	19				

Battery Organization. Bangna.

Type .....

Current ....10..... Amps.

No.of ....Discharge....2.....

Battery No. ....M-6.....

Remarks

12V.24PL.

Rated capacity at 20 Hr-rate 200Ah

Discharge at 20 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
19	00	11.24	188	206	20			32.5	10
			188	207	20	-	92		
			188	207	20				
			186	206	21				
			187	205	19	-	92		
			187	207	21				
19	30	11.09	186	204	19			34.7	10
			186	205	20	-	84		
			186	205	20				
			182	204	23				
			184	202	19	-	84		
			185	205	21				
19	45	10.97	184	202	17			34.7	10
			185	204	20	-	85		
			184	204	20				
			179	202	24				
			182	200	19	-	85		
			183	204	22				
20	00	10.96	182	202	21			35.0	10
			184	205	22	-	83		
			183	204	22				
			174	202	29				
			181	200	20	-	83		
			182	204	24				

Battery Organization. Bangna.

Current 10 Amps.

No.of Discharge 2

Battery No. M-6

12 x 24 PL.

Rated Capacity at 20 Hr-rate 200Ah.

Discharge at 20 Hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°F)	Amps.
20	15	10.53	179	199	20			35.0	10
			182	204	22	—	85		
			181	202	22				
			154	195	41				
			171	196	19	—	85		
			179	202	24				
cut off	voltage	10.50	at 20.25	Hr.					

Battery Organization. Bangna.

Type 2 H

Current 12 Amps.

No. of Discharge 3

Battery No. M-1

Remarks

6 V 17 PL

Rated Capacity at 20 Hr-rate 120 Ah.

Discharge at 10 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°F)	Amps.
H	M			Pos.	Neg.				
open	ckt.	6.54	218	224	08			81	
			218	226	10	1.271	83		
			218	227	10				
Start		6.30							12
0	5	6.20							12
0	15	6.21							12
0	30	6.23							12
1	00	6.21	207	216	10			81	12
			207	217	11	1.261	83		
			207	218	12				
2	00	6.18	206	216	11			81	12
			206	217	12	1.236	81		
			206	218	12				
3	00	6.11	203	214	12			81	12
			204	216	12	1.220	84		
			204	216	13				
4	00	6.00	200	212	12			81	12
			200	213	13	1.200	84		
			200	214	14				

Battery Organization. Banyna.

Type ..2 H.....

Current ..12.....Amps.

No. of ..Discharge 3.....

Battery No. ..M-1.....

Remarks

6 V 17 PL.

Rated Capacity at 20 Hr-rate 120Ah.

Discharge at 10 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°c)	Amps.
H	M			Pos.	Neg.				
5	00	5.97	199	210	11			30	12
			199	213	12	1.175	85		
			199	213	13				
6	00	5.94	198	210	12			33	12
			198	212	14	1.150	85		
			198	213	15				
7	00	5.85	195	209	14			30.5	12
			195	210	16	1.140	80		
			195	211	17				
8	00	5.75	192	207	16			32	12
			192	208	16	1.115	83		
			191	208	17				
9	00	5.56	187	204	18			33.8	12
			188	205	16	1.049	85		
			181	203	23				
Cut off voltage		5.25 V.	at 9.25 Hr.						

Battery Organization. Bangna.

Type ..... A H

Current ..... 15 ..... Amps.

No. of ..... Discharge 3 .....

Battery No. ..... M-2 .....

Remarks

6V 23PL

Rated Capacity at 20 Hr-rate 150Ah

Discharge at 10 Hr-rate

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°F)	Amps.
H	M			Pos.	Neg.				
Open	ckt.	6.52	214	224	11			36.5	
			214	224	12	1.279	90		
			214	224	11				
Start.		6.30							15
0	05	6.23							15
0	15	6.25							15
0	30	6.25							15
1	00	6.27	209	218	10			36.5	15
			209	219	11	1.259	90		
			209	219	11				
2	00	6.21	207	217	10			38.0	15
			207	217	11	1.239	90		
			207	218	11				
3	00	6.15	205	217	10			38.5	15
			205	216	10	1.219	90		
			205	216	10				
4	00	6.09	203	213	11			39.0	15
			203	214	11	1.204	90		
			203	214	12				

Battery Organization. Bongna.

Type ....4 H.....

Current ....15.....Amps.

No. of ....Discharge 3.....

Battery No. ....M-2.....

Remarks

6 V 28 PL

Rated Capacity at 20 Hr-rate 150 Ah

Discharge at 10 Hr-rate

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
5	00	6.00	200	213	12			31.5	15
			200	213	13	1.182	87		
			200	213	13				
6.	00	5.97	199	211	14			31.0	15
			199	212	15	1.168	87		
			199	214	16				
7	00	5.88	196	210	14			31.0	15
			196	210	15	1.143	87		
			196	211	16				
8	00	5.79	193	208	15			30.0	15
			193	209	17	1.122	85		
			193	210	18				
9	00	5.64	188	205	17			31.0	15
			188	205	18	1.097	85		
			188	206	19				
9	30	5.52	184	202	19			31.0	15
			186	206	21	-	85		
			184	206	23				
	Cut off Voltage at 5.25 V at 9.45 Hr								

Battery Organization. Banjna.

Type ...4.D.....

Current ....15.....Amps.

No. of ...Discharge 3.....

Battery No. ..M-S.....

Remarks

12 v 23 PL.

Rated Capacity at 20 Hr-rate 150Ah.

Discharge at 10 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
open	ckt	12.89	214	222	09			30	
			215	223	10	1.291	85		
			215	224	10				
			215	224	10				
			215	224	10	1.291	85		
			215	224	10				
Start		12.60							15
0	05	12.43							15
0	15	12.50							15
0	30	12.50							15
1	00	12.53	208	218	10			30	15
			209	219	12	1.277	85		
			209	220	12				
			209	220	12				
			209	220	12	1.277	85		
			209	220	12				
2	00	12.47	207	217	12			30	15
			208	219	13	1.256	83		
			208	220	14				
			208	220	14				
			208	221	14	1.256	83		
			208	221	14				

Battery Organization. Bangne.

Type ..AD.....

Current ....15.....Amps.

No. of ....Discharge 9.....

Battery No. ....M-S.....

Remarks

12 Y 9 8 PL

Rated Capacity at 20 Hr-rate 150AH

Discharge at 10 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
3	00	12.36	206	214	15			30.0	15
			206	216	12	1.241	93		
			206	218	13				
			206	218	14				
			206	219	14	1.241	83		
			206	220	15				
4	00	12.24	204	214	12			31.5	15
			204	216	13	1.211	83		
			204	217	15				
			204	218	15				
			204	218	15	1.211	83		
			204	218	16				
5	00	12.12	202	212	12			33.0	15
			202	214	14	1.146	83		
			202	215	14				
			202	216	15				
			202	217	16	1.196	83		
			202	217	16				
6	00	1198	199	210	13			35.6	15
			200	213	14	1.177	85		
			200	214	16				
			200	214	16				
			200	214	16	1.177	85		
			199	215	17				

Battery Organization. Bangna.

Type ...A.D.....

Current ....15.....Amps.

No. of ....Discharge 3.....

Battery No. ....M-5.....

Remarks

12 Y 23 pl.

Rated Capacity at 20 Hr-rate 150Ah

Discharge 10 Hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
7	00	11.81	196	209	13			34.0	15
			197	210	14	1.152	85		
			197	211	15				
			197	212	16				
			197	212	16	1.152	85		
			197	213	18				
8	00	11.64	194	211	19			35.7	15
			194	212	19	1123	87		
			194	211	19				
			194	211	18				
			194	212	19	1123	87		
			194	212	19				
9	00	11.37	189	204	16			36.0	15
			189	205	17	—	87		
			190	208	19				
			190	208	19				
			190	208	19	—	87		
			189	208	21				
9	30	11.09	183	204	22			36.5	15
			185	205	21	—	87		
			185	206	22				
			186	206	21				
			185	206	21	—	87		
			184	206	23				
Cut off voltage		10.50 V.	at 10.0	Hr.					

Battery Organization. Bangna.

Type 8D

Current 19 Amps.

No. of Discharge 3

Battery No. M-6

Remarks

12 v 24 PL

Rated Capacity at 20 Hr-rate 200Ah.

Discharge at 10 Hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
Open	ckt	12.84	214	223	10			34.0	
			214	223	10	1284	90		
			214	224	11				
			214	224	11				
			214	224	11	1.284	90		
			214	224	11				
Start		12.50							19
0	05	12.42							19
0	15	12.42							19
0	30	12.45							19
1	00	12.48	208	218	11			33.8	19
			208	218	11	1.264	90		
			208	219	11				
			208	219	12				
			208	219	12	1.264	90		
			208	219	12				
2	00	12.49	207	217	11			35.2	19
			207	218	11	1.250	90		
			207	218	11				
			207	217	11				
			207	217	11	1.250	90		
			207	218	11				

Battery Organization. Bangna.

Type 3D

Current 19 Amps.

No. of Discharge 3

Battery No. M-6

Remarks

12 v. 24 PL.

Rated Capacity at 20 Hr-rate 200 Ah

Discharge at 10 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
3	00	12.30	205	216	11			36.0	19
			205	217	12	1234	90		
			205	217	12				
			205	216	11				
			205	216	11	1234	90		
			205	217	12				
4	00	12.14	203	214	11			37.0	19
			202	214	12	1204	90		
			203	214	12				
			202	214	11				
			202	214	12	1209	90		
			202	215	12				
5	00	12.06	201	212	14			37.0	19
			201	213	13	1184	92		
			201	214	14				
			201	214	14				
			201	214	14	1179	92		
			201	214	14				
6	00	11.94	199	211	13			37.0	19
			199	212	15	1164	90		
			199	213	15				
			199	214	16				
			199	214	16	1164	90		
			199	214	16				

Battery Organization. Bangna.

Type S P

Current 19 Amps.

No. of Discharge 3

Battery No. M-6

Remarks

12 V 29 Pl.

Rated Capacity at 20 Hr-rate 200 Ah.

Discharge at 10 Hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
7	00	11.70	195	212	16			34.0	19
			195	211	16	1.144	90		
			195	212	17				
			195	212	18				
			195	211	17	1.144	90		
			195	212	18				
8	00	11.52	192	207	15			33.0	19
			192	208	17	1.119	90		
			192	209	18				
			192	210	19				
			192	209	18	1.114	90		
			192	210	19				
9	00	11.17	187	201	12			31.5	19
			187	204	18	1.094	90		
			187	205	19				
			184	206	22				
			186	203	19	-	90		
			186	206	21				
9	30		180	197	19			31.5	19
			181	202	22	-	90		
			181	203	22				
			160	200	42				
			178	196	20	-	90		
			179	203	25				
Cut off	voltage	10.50 V.	at 9.5	Hr.					

Battery Organization. Banyan.

Type ...2 H.....

Current .....20..... Amps.

No.of ...Discharge...4.....

Battery No. M-1.....

Remarks

6 V 17 PL

Rated capacity at 20 Hr-rate 120 Ah.

Discharge at 5 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°F)	Amps.
H	M			Pos.	Neg.				
Open	Ckt	6.44	215	224	10			30.0	
			214	225	11	1278	85		
			215	225	12				
Start		6.20							20
0	05	6.15							20
0	15	6.15							20
0	30	6.15							20
1	00	6.15	205	216	12			29.0	20
			205	218	12	1256	83		
			205	218	12				
2	00	6.03	201	213	12			31.0	
			201	213	12	1217	84		
			201	213	12				
3	00	5.94	198	200	12			32.0	20
			198	200	12	1197	85		
			198	200	12				
4	00	5.83	194	208	14			33.0	20
			195	208	14	1157	85		
			194	208	14				

Type ..... 2 H

Current ..... 20 ..... Amps.

No.of ....Discharge....4.....

Battery No. M-1

Remarks

6 V. 17 PL.

Rated Capacity at 20 Hr-rate 120 Ah.

Discharge at 5 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
5	00	5.33	185	202	18			34	20
			186	202	17	1.208	88		
			162	196	37				
	Cut off Voltage		5.25 V	at 5.05	Hr.				

Battery Organization. Bangma.

Type ....4 H.....

Current ....20.....Amps.

No. of ....Discharge 4.....

Battery No. ....M-2.....

Remarks

6 v 22 Pl.

Rated Capacity at 20 Hr-rate 150 Ah

Discharge at 5 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°F)	Amps.
H	M			Pos.	Neg.				
Open	ckt.	6.43	215	223	09			37.0	
			215	223	09	1285	93		
			215	223	09				
Start		6.25							20
0	05	6.23							20
0	15	6.21							20
0	30	6.23							20
1	00	6.21	207	217	10			38.7	20
			207	217	10	1270	92		
			207	217	10				
2	00	6.12	204	215	10			34.0	20
			204	214	11	1234	90		
			204	215	11				
3	00	6.06	202	213	12			32.8	20
			202	212	12	1214	90		
			202	213	12				
									20
4	00	5.97	199	212	10			32.0	
			199	213	12	1182	87		
			199	214	12				

Battery Organization. Banyan.

Type ....4 H.....

Current ....20.....Amps.

No. of ....Discharge..4.....

Battery No. ..M-2.....

Remarks

6 V 23 Pl

Rated Capacity at 20 Hr-rate 150 Ah.

Discharge at 5 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
4	30	5 91	197	211	14			32.0	20
			197	213	16	1.168	87		
			197	213	16				
5	00	5 85	195	208	14			32.0	20
			195	212	16	1.153	87		
			195	212	17				
5	30	5.76	192	208	16			31.5	20
			192	210	17	1.137	85		
			192	210	17				
6	00	5.66	189	204	16			31.5	20
			189	207	18	1.120	85		
			188	208	19				
6	30	5.52	184	200	17			31.5	20
			184	205	20	1.107	85		
			184	206	22				
6	45		178	196	20			31.0	20
			180	202	23	1.092	85		
			176	201	25				
	Cut off	Voltage	5.25 at	6.82 Hr					

Battery Organization. Range.

Type ....4 D.....

Current ....22.....Amps.

No. of ...Discharge 4.....

Battery No. ..M-5.....

Remarks

12V 23 Pl.

Rated Capacity 20 Hr-rate 150 Ah

Discharge at 5 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
open	ckt	1275	212	222	10			31.0	
			212	222	10	1278	87		
			212	224	12				
			214	224	10				
			213	224	11	1278	87		
			212	224	12				
Start		1237							22
0	05	1230							24
0	15	1240							24
0	30	1240							22
1	00	1236	206	216	10			31.0	22
			206	218	12	1257	85		
			206	218	12				
			206	219	13				
			206	219	13	1257	85		
			206	219	13				
2	00	1220	203	213	12			31.0	24
			203	215	12	1227	85		
			203	216	14				
			204	217	14				
			204	217	14	1227	85		
			203	217	14				

Battery Organization. Bunyns.

Type ....A.....

Current ....24..... Amps.

No.of ....Discharge 4.....

Battery No. ..M-5.....

Remarks

12V- 23 PL

Rated Capacity at 20 Hr-rate (50 AH

Discharge at 5 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
3	00	12.00	200	212	14	[illegible]		31.0	24
			200	214	14	1.197	85		
			200	214	15				
			200	215	15				
			200	215	15	1.197	85		
			200	216	16				
4	00	11.78	196	209	14			30.5	24
			196	211	16	1.167	85		
			196	212	16				
			197	212	16				
			197	213	17	1.167	85		
			196	213	18				
5	00	11.54	192	206	16			30.5	22
			192	208	17	1.142	85		
			192	210	18				
			193	210	17				
			193	210	18	1.142	85		
			192	210	18				
6	00	11.20	188	202	14			30.0	24
			188	204	14	1.112	85		
			189	203	15				
			189	203	14				
			188	203	14	1.112	85		
			188	203	15				

Battery Organization. Bangna.

Type ....4.P.....

Current ....22.....Amps.

No. of ....Discharge..4.....

Battery No. M.T.S.....

Remarks

12V 23PL.

Rated Capacity 20 Hr-rate 150Ah

Discharge at 8 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
6	15	11.01	184	200	14			30.0	22
			184	202	16	1100	85		
			184	204	16				
			184	202	14				
			183	204	16	1100	85		
			182	204	16				
6	30	10.92	180	148	18			30.0	22
			180	202	18	—	85		
			180	202	18				
			182	200	18				
			182	202	18	—	85		
			178	200	18				
6	35	10.58	170	148	20			30.0	22
			176	198	21	—	85		
			178	200	22				
			180	200	21				
			178	149	21	—	85		
			176	148	21				
	cut off Voltage 10.50 at 6.67 Hrs								

Battery Organization. Bangna.

Type ..... X D .....

Current ..... 31 .....Amps.

No. of ..... Discharge 4 .....

Battery No. ..... M-8 .....

Remarks

12 V 24 AL

Rated Capacity at 20 Hr-rate 200Ah

Discharge at 5 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°F)	Amps.
H	M			Pos.	Neg.				
open	ckt	12.73	212	220	07			30.0	
			213	221	09	1277	85		
			212	221	10				
			212	222	10				
			212	223	11	1277	85		
			212	223	11				
Start		12 50							31
0	05	12.30							31
0	15	12.36							31
0	30	12.36							31
1	00	12.35	206	217	13			32 0	31
			206	218	12	1258	87		
			206	218	12				
			205	218	13				
			206	218	13	1258	87		
			206	218	14				
2	00	12 17	203	215	13			33.5	31
			203	217	14	1218			
			203	217	15				
			202	217	15				
			203	217	15	1218			
			203	216	15				

Battery Organization. Bongna.

Type ...P.....

Current ...31.....Amps.

No. of ...Discharge 4.....

Battery No. ...M-6.....

Remarks

12 V 29 PL.

Rated Capacity at 20 Hr-rate 200 Ah

Discharge at 5 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
3	00	11.90	200	215	15			33.8	31
			200	215	16	1.193	87		
			200	214	16				
			199	216	17				
			200	216	16	1193	87		
			200	216	17				
4	00	11.75	190	209	13			35.5	31
			196	209	13	1163	87		
			196	210	14				
			195	210	15				
			196	211	15	1158	87		
			196	212	16				
5	00	11.41	191	214	14			35.5	31
			190	216	16	1123	87		
			190	216	16				
			190	217	18				
			190	217	18	1118	87		
			190	209	20				
	Cut off	voltage	10.5 at	5.25	Hr.				

Battery Organization. Bangna.

Type 2H

Current ..... 72 Amps.

No. of ..... Discharge 5

Battery No. M-1

Remarks

6V 17PL.

Rated Capacity at 20 Hr-rate 120Ah.

Discharge at 1 Hr-rate

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
open	ckt.	6.43	214	223	09			35.7	
			214	223	09	1.279	90		
			215	224	09				
Start		6.12						•	72
0	05	6.00	200	215	15			36.3	72
			200	215	14	1.274	90		
			200	214	14				
0	15	5.91	197	213	15			36.3	72
			197	212	15	1.244	90		
			197	212	15				
0	30	5.83	195	215	19			36.3	72
			194	212	17	1.229	90		
			194	212	17				
0	45	5.70	190	210	21			36.5	72
			190	210	20	1.204	90		
			190	209	20				
1	00	5.41	181	206	25			36.5	72
			182	206	24	1.170	93		
			178	203	26				
		cut off	voltage	5.00 V	at 5.13	hr.			

Battery Organization. Bangna.

Type ..... 4 Hr. .....

Current ..... 90 ..... Amps.

No. of ..... Discharge 5. .....

Battery No. ..... M-2 .....

Remarks

6V23PL.

Rated Capacity at 20 Hr-rate 150 Ah

Discharge at 1 Hr-rate

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Isolation (V) Pos.	Isolation (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°F)	Amps.
Open ckt.		6.48	216	224	08			32	
			216	225	09	1.283	87		
			216	225	09				
Start.		6.10						32	90
0	05	6.00	200	214	14			32	90
			200	215	14	1.283	87		
			200	215	14				
0	15	5.98	200	213	14			32	90
			198	214	15	1.269	90		
			200	215	15				
0	30	5.92	198	212	15			32	90
			197	214	18	1.254	90		
			197	214	16				
0	45	5.73	193	212	17			32	90
			192	212	19	1.214	90		
			193	212	20				
1	00	5.56	186	204	19			32	90
			185	208	22	1.189	90		
			185	208	22				
1	05	5.32	178	200	22			32	90
			177	206	28	1.169	90		
			177	206	28				
		Cut off Voltage	5.00 at	1.15	Hr.				

Battery Organization. Ranging.

Type ....4D.....

Current ....90.....Amps.

No. of ....Discharge 5.....

Battery No. ....M-5.....

Remarks

12 V 23 PL

Rated Capacity at 20 Hr-rate 150 AH

Discharge at 1 Hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
open	ckt	1296	214	223	10			32.5	
			214	224	10	1.283	87		
			215	226	12				
			215	226	12				
			214	226	12	1.283	87		
			214	226	12				
Start		12.29						32.5	90
0	05	12.00	200	215	15			32.5	90
			200	216	16	1.278	87		
			200	217	17				
			200	217	17				
			200	217	17	1.278	87		
			200	217	17				
0	15	11.98	199	214	15			33.0	90
			199	216	16	1.259	90		
			200	217	16				
			200	216	16				
			200	216	16	1.259	90		
			200	217	17				
0	30	11.77	196	212	16			33.5	90
			196	214	17	1.234	90		
			197	214	17				
			196	215	17				
			196	214	18	1.234	90		
			196	215	19				

Battery Organization. Bangna.

Type ....4 D.....

Current ....90.....Amps.

No. of ....Discharge 5.....

Battery No. ...M-S.....

Remarks
12 V 23 PL.

Rated Capacity at 20 Hr-rate 150th
Discharge at 1 Hr-rate.

Time		Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V)		Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
H	M			Pos.	Neg.				
0	45	11-56	193	210	17			34.0	90
			193	211	19	1209	90		
			193	213	20				
			193	211	19				
			192	212	21	1209	90		
			192	212	21				
1	00	11-16	186	208	20			34.0	90
			186	208	22	1185	93		
			186	209	22				
			186	207	21				
			186	209	23	1185	93		
			182	209	24				
	Cut off	Voltage	10.0 Volts	at 1.56	Hr				

Battery Organization. Bangna.

Type ..E.D.....

Current ..120.....Amps.

No. of ...Discharge 5.....

Battery No. .M-6.....

Remarks

12 V 24 PL

Rated capacity at 20 hr-rate 200 AH

Discharge at 1 hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Cadmium (V) Pos.	Cadmium (V) Neg.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
open	ckt	12.96	216	225	10			32	
			216	225	10	1271	90		
			216	226	10				
			216	226	10				
			216	225	10	1271	90		
			216	226	10				
Start		12 60							120
0	05	1250	201	215	14			32	120
			201	216	16	1263	87		
			201	216	16				
			200	216	16				
			201	216	15	1263	87		
			201	218	17				
0	15	1190	199	213	15			32	120
			199	215	17	1248	87		
			198	215	17				
			198	216	17				
			198	215	17	1248	87		
			198	217	19				
0	30	1161	194	208	16			33	120
			193	211	18	1224	40		
			194	211	14				
			193	212	19				
			194	211	18	1224	90		
			193	213	20				

Battery Organization. Bangna.

Type ..S.P.....

Current .....120.....Amps.

No. of ....Discharges.....

Battery No. ..M-6.....

Remarks

12 V 29 PL.

Rated Capacity at 20hr-rate 20AH

Discharge at 1 hr-rate.

Time H	Time M	Terminal Voltage (V)	Cell Voltage (V)	Capacity (AH) Inc.	Capacity (AH) Dec.	Sp.Gr.	Cell Temp. (°F)	Room Temp. (°C)	Amps.
0	45	11-25	188	206	17			33	120
			189	207	20	1.195	92		
			188	208	21				
			186	208	22				
			189	207	20	1.195	92		
			187	210	23				
1	00	10.70	178	199	21			34	120
			177	203	27	1.170	93		
			176	203	27				
			170	202	32				
			175	197	22	1.170	93		
			174	204	30				
	cut off	Voltage	10.0V	at 1.07	hr.				

Battery Organization. Bangna.