



**C&D
INSTALLATION
AND OPERATION
INSTRUCTIONS
FOR
STATIONARY
BATTERIES**

Handwritten scribbles and lines, possibly representing a circuit diagram or technical notes.

**C&D BATTERIES, DIV. THE ELECTRIC
AUTOLITE CO., CONSHOHOCKEN, PA.**

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1.00 RECEIVING

Every precaution has been used in packing the battery for shipment to assure its safe arrival. Promptly upon delivery from the carrier, check the packing material for evidence of damage in transit. Spillage or leakage of electrolyte is indicated by wet acid stains. Broken or damaged boxes would be evidence of rough handling. If any of the above are observed, make a note of it on the bill of lading before signing.

At the first opportunity, check the electrolyte in each cell. It should be within $\frac{1}{4}$ " of the high level indicator. If the level is more than $\frac{1}{2}$ " below the top of the plates, order a new cell and file a claim for concealed damage against the carrier. If the plates are covered, but the level is lower than $\frac{1}{4}$ " below the high level indicator, add battery grade or chemically pure sulfuric acid of 1.210 specific gravity to any low level cells in order to bring them up to the average level of the other cells.

See Section 6.26 for more details.

2.00 UNPACKING-HANDLING

Cells or units are packed in individual cartons strapped to a wood pallet. Remove the straps and collapse the cartons. Always lift cells from the bottom of the container; never by the cell posts. A lifting sling and spreader block are provided and are packed in the accessories box with large cells of 180 ampere hours or more capacity. Tilt the cell and slip the lifting sling under the center of the cell, then install the spreader block with beveled edges up on the top of the cell. Use the lifting holes in the sling as shown in Figure 1 to lift the cell.

3.00 INSTALLATION

3.10 LOCATION

Whenever possible, install the battery in a clean, cool, dry, place so that some cells are not affected by sources of radiant heat such as sunshine, heating units, radiators, or steam pipes. The battery is an electrochemical device and variations in temperature of more than 5°F. may cause the warmer cells to become unequal.

See Section 7.40.

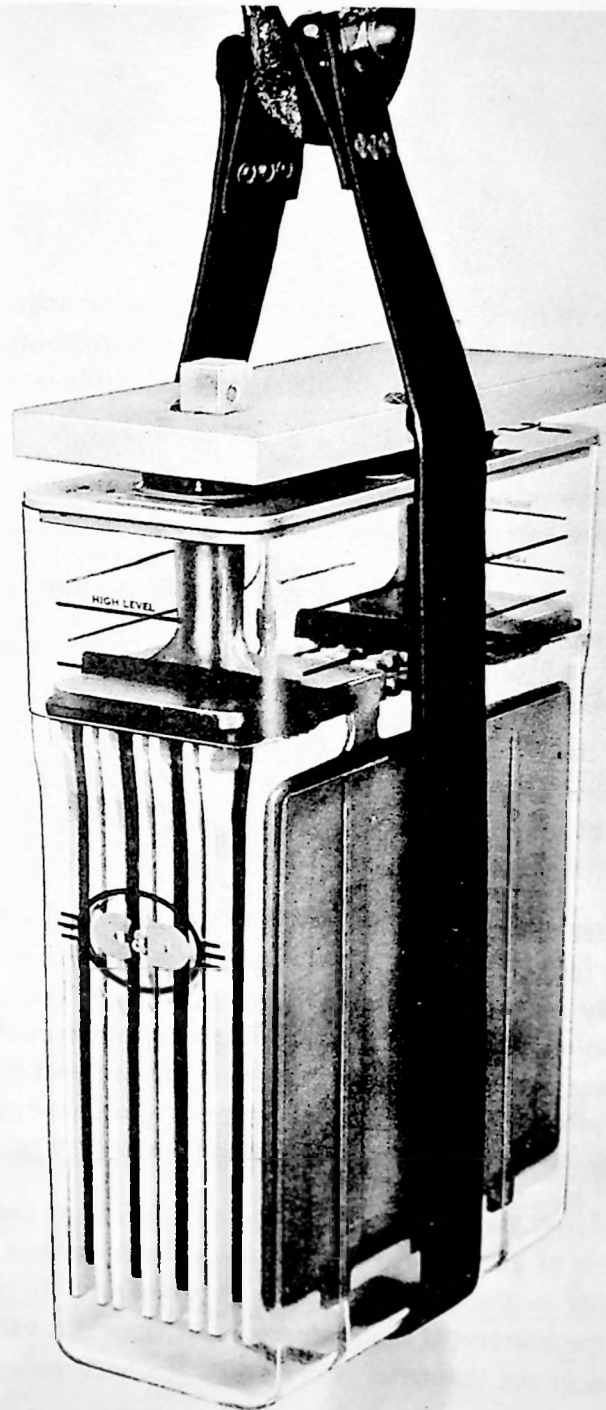


FIGURE 1
Use of lifting sling and spreader block simplifies lifting of cells and reduces possibility of damage.

3.20 RACKS

These can be from one to three tiers, or two or three steps arranged back to back, end to end, or separate. They are made of steel angle supports and channel rails. Rail insulation supplied consists of molded rubber or plastic strips. Assembly instructions and drawings are packed with the rack.

When locating the racks or rack sections, consider ease of cell accessibility so that individual cell readings and water additions may be made without difficulty.

In Figure 2 a typical two step rack is shown with cells centered on the rails, spaced $\frac{1}{2}$ " between units and connected together.

3.30 CONNECTING CELLS

Arrange the cells on the rack so that the positive terminal of each cell can be connected to the negative terminal of the next cell. Positive cell terminals are marked with symbols molded into the cover. A plus sign (+) denotes the positive terminal and a minus sign (-) indicates the negative terminal of the cell.

If more than one inter-cell connector per cell is furnished, mount them on each side of the cell post. Do not remove the film of No-Ox-Id grease which is applied to the cell posts at the factory. Apply a film of No-Ox-Id grease to both sides of the connectors where they are to be bolted to the posts and also to the bolt connectors. Tighten the bolt connector firmly, but not severely. Lead is a soft metal and will flow or distort under too much pressure. Remove any surplus grease which may squeeze out of the connection. Do not remove grease from the post or connector surfaces. *See Figure 6.*

Recheck the cell polarity for positive to negative connections throughout the battery and recheck the tightness of all bolt connectors. As a further check, read the voltage of the total number of cells in the battery with a dc voltmeter. It should be 2.05 times the number of cells in the battery. If the reading is less than this value, one or more cells are installed backwards, or the voltmeter is incorrect. Recheck polarities of all cells.

When cells are in their final position on the rack, remove and discard the temporary shipping vent plugs, which are provided for types CE, CF, F, PCE, PCL, PCR, PF, PCF, PL, PR and replace them with the patented C & D "Saftee Vents"* provided.

*Optional Purchase.

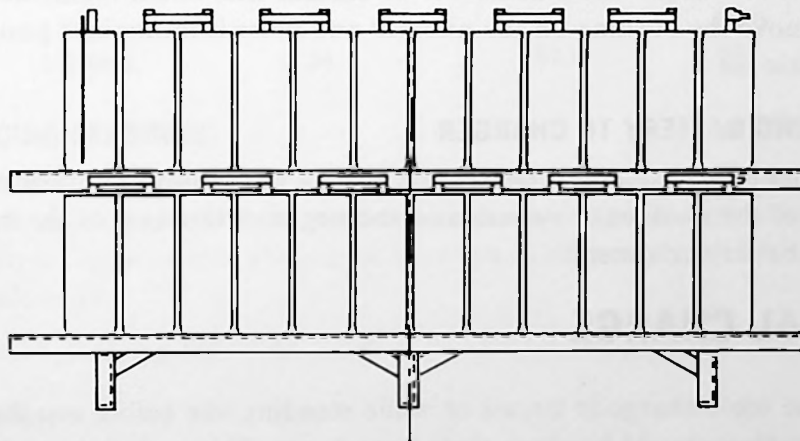
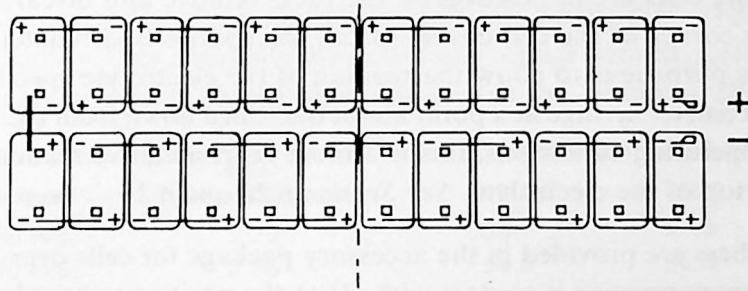
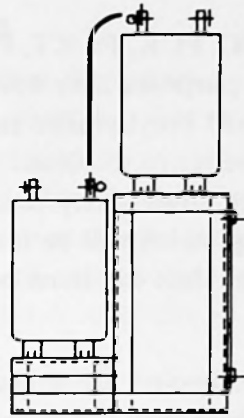


FIGURE 2
Plan and elevation views of a two step rack with cells in place.

For types C, D, DA, DC, DCA, PCC, PCK, PCKT, PK, PKT "Saftee Vent"* plugs are already in position, but for shipping purposes have been baffled with a wad of glass wool held in position by a wide strip of red vinyl plastic tape. Remove and discard the tape and glass wool. "Saftee Vents" are designed to permit the taking of hydrometer readings without being removed. However, in some dusty locations it is desirable to cover the "Saftee Vent" with a plastic dust cap which will be furnished at no charge upon request to the local C&D Representative. The dust cap must be removed and replaced when taking hydrometer readings.

Smaller cells (6 to 30 ampere hour capacity) are shipped with a red polyethylene plastic plug having a serrated perimeter. These may either be retained or discarded.

A special hydrometer reading tube is packed separately for each cell type CF, F, PCF, and PF. After the cells are in position on the rack, remove and discard the small screw cap in the aisle corner of the cell cover. Install the special hydrometer reading tube in this opening. Its purpose is to allow the reading of the electrolyte specific gravity with a long nozzle hydrometer syringe at a point about one-third down from the top of the plates. Under certain operating conditions, this is a more representative reading than would be obtained at the top of the electrolyte. *See Section 6.22 and 6.23*

Plastic cell numbers are provided in the accessory package for cells over 100 ampere hour capacity. Customary practice is to start with (1) at the positive terminal and to follow the electrical circuit with succeeding numbers. To install, first chalk mark the location on the jar, then remove the backing on the number and press it firmly into position. Do not scratch the plastic jar.

3.40 CONNECTING BATTERY TO CHARGER

Only direct current (dc) is used for charging. Connect the positive terminal of the battery to the positive of the charger or system and the negative terminal of the battery to the negative of the battery or system.

4.00 INITIAL CHARGE

All batteries lose some charge in transit or while standing idle before installation. At the first opportunity they should be given their first charge. This is done by either adjusting the charging rate (amperes) to the finish rate value shown in the table on Pages 21, 22, 23 or, if the system voltage is limited, to the maximum voltage allowable.

**Optional Purchase.*

4.10 CONSTANT CURRENT METHOD

(Use where total voltage will not affect the system.)

Place the battery on charge at its normal finishing rate given in the table on Pages 21, 22, 23. Continue the charge at this value in amperes until individual cell voltages and gravities stop rising, then for 3 more hours. If the amperes charge rate used is much less than the normal finish rate, increase the 3 hour maximum period proportionately. For example, if one-half the finish rate, charge until cell voltages and gravities stop rising, then for 6 more hours; if one-quarter the finish rate, charge to a 12 hour maximum in specific gravity and voltage.

4.20 CONSTANT VOLTAGE METHOD

This method of giving the initial charge is used when circuit voltage limitations make it impractical to use the constant current method. First determine the maximum allowable voltage that may be applied to the connected equipment. Divide this voltage by the number of cells in the battery, thus obtaining the maximum voltage per cell. Refer to the following table and charge the battery for the time indicated at the maximum allowable voltage.

TIME		CELL VOLTS	APPROXIMATE TOTAL VOLTAGES FOR		
Calcium	Antimony		23 CELLS	24 CELLS	60 CELLS
2½ Wks.	40 Hrs.	2.39	55	57.5	144
3½ Wks.	60 Hrs.	2.36	54.5	56.5	142
4¾ Wks.	80 Hrs.	2.33	53.5	56	140
6½ Wks.	110 Hrs.	2.30	53	55	138
10 Wks.	1 Week	2.27	52	54.5	136
12½ Wks.	1¼ Wks.	2.24	51.5	54	135

4.30 RECORDING READINGS

At the completion of the initial charge, record voltages and specific gravities of individual cells while still on charge and keep for future reference. Specific gravities, (corrected to 77°F. electrolyte temperature) should be between 1.200 and 1.220 with the electrolyte level at the full mark.

See Sections 6.24, 6.25 and Figure 4.

4.40 CAUTION

All storage batteries give off explosive gasses when charging. Cells equipped with "Saftee Vents" are protected from internal explosions, but caution should still be used not to bring open flame or sparks near the battery.

5.00 OPERATION

5.10 FLOAT CHARGING

Most stationary batteries are continuously connected to vital circuits which must be energized at all times. This is accomplished by connecting the battery in parallel with a continuously operating charger and the desired load circuits. The charger is then adjusted to a voltage which will enable the battery to absorb just enough current to keep it fully charged. The charger also furnishes current for the connected load. This is called floating operation. It assures a fully charged battery ready instantaneously for any emergency.

5.11 Antimony Batteries

Adjust the charger voltage to average 2.15 to 2.17 volts per cell.

5.12 Calcium Batteries

For telephone service, adjust the charger voltage to average between 2.17 and 2.20 volts per cell. For other services, adjust to between 2.17 and 2.25 volts per cell. If lead calcium cells are floated between 2.20 and 2.25 volts, they should never require an equalizing charge.

5.13 Automatic Features

At these floating voltages, the battery automatically takes whatever charging current it needs to maintain itself fully charged. This is at normal (60°-90°) temperature, but is irrespective of age.

5.14 Voltmeter Calibration

Panel voltmeters used for float charging circuits should be kept in accurate calibration by checking with a known standard every six months.

5.20 EQUALIZING CHARGE

This is a charge given at a higher voltage than the floating charge for a definite number of hours depending upon the value of the charge voltage. Its purpose is to compensate for any irregularities that may have occurred, such as low floating voltage for a prolonged period of time due to faulty adjustment of the charger, or to a panel voltmeter which is improperly calibrated on the high side. It is also useful in restoring the battery to full charge in a minimum time after an emergency discharge.

5.21 Antimony Batteries

Antimony batteries require an equalizing charge in accordance with the following table at one to three month intervals:

CELL VOLTS	TIME	APPROXIMATE TOTAL VOLTAGE FOR		
		23 CELLS	24 CELLS	60 CELLS
2.39	10 Hrs.	55	57.5	144
2.36	15 Hrs.	54.5	56.5	142
2.33	20 Hrs.	53.5	56	140
2.30	30 Hrs.	53	55	138
2.27	40 Hrs.	52	54.5	136
2.24	60 Hrs.	51.5	54	135

5.22 Calcium Batteries

Calcium batteries require an equalizing charge only when any cell reads below 2.13 volts while floating at an average of at least 2.17 volts. If this condition occurs, raise the charger voltage to the maximum permitted by circuit limitations until the lowest cell reads higher than .05 volts below the average, or for the time indicated in the above table, whichever is longer.

5.23 After Emergency Discharge

Equalizing charges should be given to antimony batteries after an emergency discharge of any duration. This also applies to calcium batteries floating at 2.17 volts. This assures their being recharged in the shortest possible time, thus putting them in condition to handle the next emergency. At the conclusion of an equalizing charge, resume normal float operation.

5.30 WATER ADDITIONS

As batteries are charged, a small quantity of the water in the electrolyte is broken down into hydrogen and oxygen by the charging current. These gasses are dissipated through the opening in the vent plugs. As this takes place, the electrolyte level gradually lowers so that from time to time, it is necessary to replace this loss with water. Keep the electrolyte level between the high and low level indicators by adding approved or distilled water as required.

On plastic container cells, the high and low level limits are marked by lines on the container. On rubber container cells, an electrolyte level float is provided. This is assembled in a cage which is mounted in a hole in the cover. With the green tip of the float barely showing, the electrolyte level is at the low point. The high level is indicated when red color shows on the float.

If in doubt about the suitability of the local water supply for use in storage batteries, consult your nearest C & D Representative. If he does not have a recent analysis report available, send a two quart sample in a chemically clean non-metallic container and stopper, prepaid to C & D Batteries, Div. The Electric Autolite Co., Conshohocken, Pennsylvania. The sample will then be analyzed free of charge and a report as to its safety for use in storage batteries will be forwarded. Indicate the source of the water and the sender's name and location on the sample.

The quantity of water consumed by a battery is proportional to the amount of charge it receives. Antimony batteries begin their life with low water consumption, which increases as much as five times toward the end of their life. Calcium batteries, because of the greater purity of their components, require only about one tenth of the amount needed by equivalent sized new antimony batteries. This low requirement remains constant during their entire life. Figure 3 gives the approximate water consumption for various size cells at the normal operating temperature of 77°F.

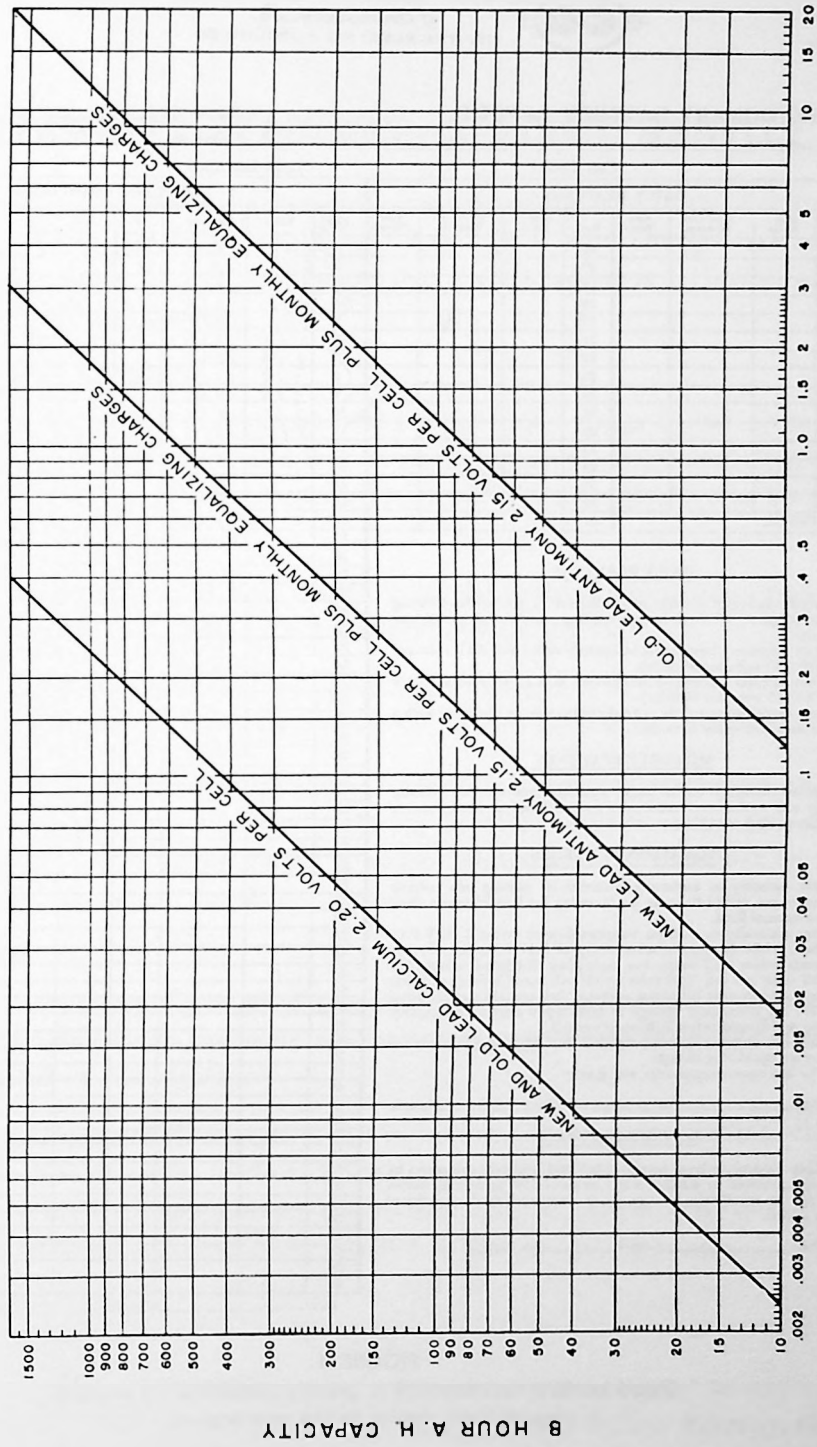
5.40 CLEANING

Wipe the outside of the cells as necessary with a water moistened rag to remove dust and ordinary dirt. If electrolyte is spilled on the covers, neutralize it with a rag moistened with a solution of baking soda and water mixed in the proportion of a half pound of soda to one quart of water. When fizzing stops as fresh soda solution is applied, wipe with a water moistened rag to remove traces of soda. Always keep the connectors, posts, covers and containers clean and dry.

5.50 RECORDS

A record of the battery's operation and condition is useful in assuring good service and long life. Use report form RS-103 shown in Figure 4, or a similar one. Take and record the readings at intervals consistent with the maintenance schedule. Write down the hydrometer readings as read. If irregularities occur, consult the nearest C & D Representative or send a copy of the latest report to the manager of Headquarters Service, C & D Batteries, Div. The Electric Autolite Co., Conshohocken, Pennsylvania, for analysis and recommendations.

APPROXIMATE WATER CONSUMPTION
 FLOATING OPERATION
 1.210 SPECIFIC GRAVITY - 77°F



PINTS WATER CONSUMPTION PER CELL PER YEAR

FIGURE 3
 Comparison of water consumption of various type cells.



$E = 26.9 V$
 $I = 47 A$

STATIONARY BATTERY REPORT

Month of _____ 19____

Company _____

Location _____

Cell Type _____

Date Installed _____

DAILY READINGS								MONTHLY READINGS						
Day	Bus Volts	Pilot Cell Hydrom.	Elec. Temp.	Day	Bus Volts	Pilot Cell Hydrom.	Elec. Temp.	Cell	Volts	Hydrom.	°F.			
1				16				1	2.13	1215	77			
2				17				2	2.13	1210				
3				18				3	2.13	1210				
4				19				4	2.13	1215				
5				20				5	2.13	1210				
6				21				6	2.13	1215				
7				22				7	2.13	1215				
8				23				8	2.14	1212				
9				24				9	2.13	1210				
10				25				10	2.13	1210				
11				26				11	2.13	1210				
12				27				12	2.14	1210				
13				28				13						
14				29				14						
15				30				15						
Pilot Cell No.				31				16						
								17						
								18						
								19						
								20						
								21						
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DAILY READINGS

Record daily, or at other specified interval, the battery floating bus volts, pilot cell hydrometer reading, and adjacent cell temperature.
 Float antimony batteries continuously at 2.15 to 2.17 volts per cell (129-130 volts for 60 cells).
 Float calcium batteries continuously at 2.17 to 2.25 volts per cell (130-135 volts for 60 cells).
 Keep panel voltmeter in correct calibration by checking with a known standard every 6 months.

MONTHLY READINGS

Record monthly or at other specified interval the floating voltage and hydrometer reading of each cell and the temperatures of 2 cells in each row.

EQUALIZING CHARGES

Give monthly to antimony batteries by raising bus volts to 2.33 volts per cell (140 volts for 60 cells), for 8 to 24 hours, then resume normal float.
 Give annually to calcium batteries floated below 2.20 V.P.C. or when, while floating at an average of 2.17 volts per cell, any cell reads below 2.13 volts. For equalizing charge raise bus volts to 2.33 volts per cell (140 volts for 60 cells) until lowest cell reads higher than .05 volt below the average, then resume normal float.
 Give an equalizing charge to both types after an emergency discharge if floated below 2.20 volts per cell.
 Calcium batteries floated between 2.20-2.25 volts per cell never require an equalizing charge.
 The last equalizing charge was given:

Date _____ at _____ volts for _____ hours.

WATER ADDITIONS

Keep electrolyte level between high and low level indicators by adding approved or distilled water as necessary, preferably before starting an equalizing charge. Note date and total quantity of water added.

Date _____ Added _____ Qts. Total.

Date _____ Signed _____

FIGURE 4
 Good battery maintenance is greatly simplified by using a report form similar to the one shown.

6.00 HYDROMETER READINGS—SPECIFIC GRAVITY

Specific gravity is a measure of the strength or weight of the acid in the electrolyte using water with a specific gravity of 1.000 as a base. In a fully charged stationary cell, the specific gravity may be 1.210. This means that the electrolyte is 1.21 times as heavy as a corresponding volume of water.

6.10 HYDROMETER READINGS

A hydrometer float inserted in a glass barrel rubber bulb syringe is used to measure the specific gravity of the electrolyte. The float is graduated in points of specific gravity, .001 equals one point. The gravity is read on the hydrometer scale at the level at which it floats in the electrolyte. See Figure 5.

When taking hydrometer readings, always hold the hydrometer syringe vertically and make sure the float is floating freely with no pressure on the bulb.

The glass parts of the hydrometer syringe should be washed as needed with warm soap and water in order to keep them clean, accurate, and to simplify readings.

The fully charged specific gravity is 1.200 to 1.220. As the battery discharges, the hydrometer will float lower because the specific gravity decreases. When recharged, the specific gravity will return to its original value. A hydrometer reading is therefore an indication of the charged or discharged condition of a cell.

6.11 Pilot Cells

One cell in a battery is usually selected as a pilot cell for recording daily readings because all cells in the series receive the same amount of charge or discharge and their specific gravities would fall or rise together.

Because a slight amount of electrolyte is lost in taking a hydrometer reading, change to a different pilot cell after about thirty readings. This distributes the loss over all the cells in the battery rather than concentrating it on one cell. Always return the electrolyte in the hydrometer syringe to the cell from which it came.

6.20 SPECIFIC GRAVITY

6.21 Loss on Float

A gradual lowering in the specific gravity of the pilot cell from day to day or week to week, would be an indication of insufficient charge caused by low floating. Ordinarily,

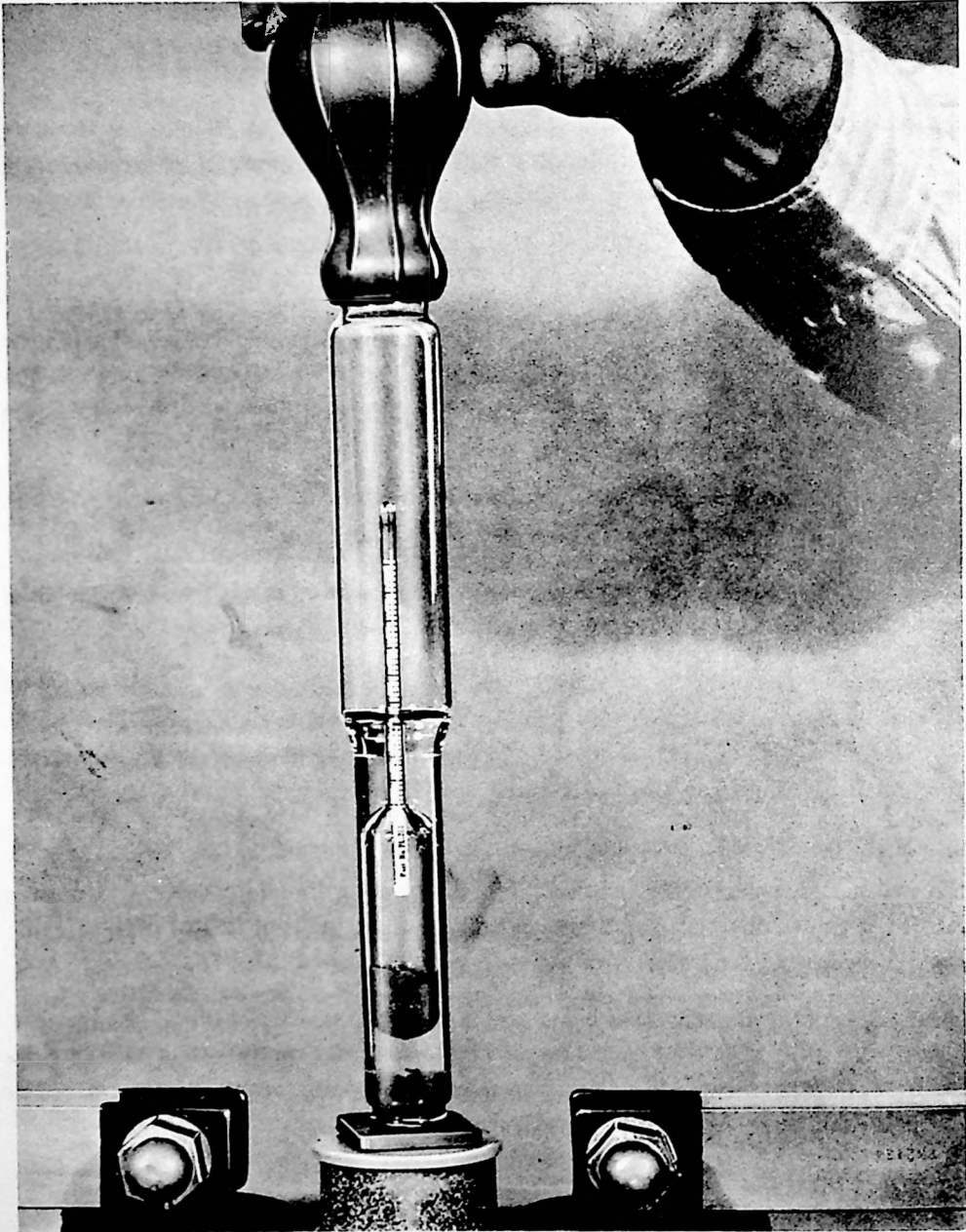


FIGURE 5

Regular hydrometer readings are essential to proper maintenance.

when the floating charge is correct, the hydrometer reading will stay close to the maximum value for that cell.

6.22 Loss after Water Addition

When water is added to a cell, it does not mix immediately with the electrolyte so that a hydrometer reading taken at this time will not indicate the true specific gravity. The mixing or diffusion time is usually several days for antimony cells and several weeks for calcium cells in floating service. These times vary with the quantity of water added.

6.23 Lag During Charge

When the battery is discharged, the specific gravity drops uniformly during the discharge period. However, on the subsequent recharge, it always lags behind the ampere hours restored on charge. This is because during charge, as strong acid is released from the plates, it falls toward the bottom of the cell from where it gradually diffuses through the entire solution. This natural diffusion rate is accelerated if the charging rate towards the end of charge is high enough to produce gassing inside the cell. This is not usually true of stationary batteries because they operate on a restricted voltage system and the charge rate tapers to so low a value that very little gassing results.

6.24 Variation With Temperature

The actual volume of electrolyte in a cell changes with the temperature which causes a change in the observed hydrometer reading. The normal or standard cell temperature is 77°F. or 25°C. If the electrolyte temperature is above this point, the observed hydrometer reading may be corrected to 77° by adding one point (.001) for each three degrees above 77°.

Conversely, if the electrolyte temperature is below 77° the hydrometer reading may be corrected to 77° by subtracting one point (.001) for each three degrees that the temperature is below 77°.

6.25 Variation with Electrolyte Level

The specific gravity reading of a cell is also affected by the electrolyte level. If the electrolyte level is at the full mark, and its specific gravity is 1.210, it will read approximately 15 points (.015) higher, or 1.225, when sufficient water in the electrolyte has been converted to gas to lower the level $\frac{1}{2}$ ". The following table illustrates how a hydrometer reading of the electrolyte will vary at different temperatures and for different levels in the same fully charged cell.

ELECTROLYTE LEVEL	ELECTROLYTE TEMPERATURES		
	62°F.	77°F.	92°F.
FULL	1.215	1.210	1.205
½" LOW	1.230	1.225	1.220
1" LOW	1.245	1.240	1.235

6.26 Electrolyte Loss Correction

The fully charged specific gravity gradually drops over a period of years at the rate of about one point (.001) per year due to a slight loss of electrolyte from spillage when taking hydrometer readings. This loss is not harmful and need not be corrected. However, it sometimes happens that one or more cells may lose an appreciable amount of electrolyte because of leakage, overfilling or spillage in handling. This loss should be promptly corrected by adding to the affected cell the same quantity and specific gravity battery grade or chemically pure sulfuric acid as was lost.

If the plates are exposed because of low level due to spillage, and the loss is detected promptly, replace it at once with the proper strength acid. If none is available, remove ¼" from other cells in the battery so that the plates of the low level cell may be covered. This loan must be replaced by obtaining the proper strength sulfuric acid and adding the correct quantity to all the cells which were involved in the transaction.

Low fully charged specific gravity may also be corrected by the addition of 1.210 acid to the low cells instead of water when the levels have dropped as indicated in the above table. For example, assume that one cell in a battery reads 1.190 with full level corrected to 77°. The other cells read normally at 1.200-1.220. The one cell is low because of acid loss which was originally, but erroneously, replaced with water. Its voltage on float and equalizing charge is about the average of the battery. When the electrolyte level, because of evaporation or water loss, has dropped to ½" below the full mark, the gravity of this cell will have increased to 1.215. It only remains then to fill this one cell to the full mark with 1.210 or 1.215 acid in order to restore it to normal gravity. The other cells would, of course, be filled with water.

Acid should never be added to a cell unless some has been lost or until it is proven by prolonged charging, such as the initial charge, that all acid is out of the plates and that the cell voltage on charge is normal. The unwise addition of acid in lieu of charging is a serious form of abuse and can result in permanent damage.

6.27 High Fully Charged Correction

High fully charged gravity, above the normal 1.200-1.220 may be adjusted downward by removing electrolyte and replacing it with water. The above table may be used as a

rough guide. For example, assume that one cell reads 1.235 specific gravity with electrolyte level at full and corrected to 77°F. If ½" of electrolyte is removed from the cell, and replaced with water, the resultant gravity will be 15 points lower or 1.220 which would put it within normal limits.

6.28 Charge Indicators

Some C & D Batteries are equipped with an assembly of three colored balls which float within a cage in the electrolyte. They are designed to float at different specific gravities depending upon the charged condition of the cell. At full electrolyte level, they indicate the following:

ALL FLOATING	FULLY CHARGED
GREEN DOWN	1/10 DISCHARGED
WHITE DOWN	1/3 DISCHARGED
RED DOWN	2/3 DISCHARGED

7.00 GENERAL

7.10 CAPACITY

Batteries are rated on an ampere hour basis, or their ability to deliver a certain number of amperes for a specified number of hours before the cell voltage drops to a certain value. Ten ampere hours could be one ampere for 10 hours, two amperes for five hours, or ten amperes for one hour. For switchgear and control service, the usual minimum or final cell voltage is 1.75. For telephone service, it may vary from 1.75 to 1.98, depending upon the operating requirements of the connected circuits.

For comparison purposes, stationary batteries are given an 8 hour discharge rating in ampere hours to 1.75 volts per cell. A cell rated at 100 ampere hours would be capable of discharging at 12.5 amperes for 8 hours before its voltage dropped to 1.75. If the discharge current taken from the cell is increased above 12.5 amperes, the total ampere hours available is less. For example, at 50 amperes discharge, the voltage would reach 1.75 in about one hour. At the one hour discharge rate therefore, the cell would be rated at 50 ampere hours to 1.75 volts.

7.20 CONNECTIONS

For the battery to perform properly on float or on discharge, it is essential that all battery connections be clean, tight and free of corrosion. When installing a battery, take a few extra minutes and inspect each cell. The posts, bolts and connecting surfaces should be

free of acid. Then coat them with a film of No-Ox-Id grease before installing the connectors. It will be time well spent and will greatly reduce the possibility of future trouble. See Figure 6. The film of grease within the connection effectively prevents the penetration of acid. All corrosion and discoloration of connections is due to the presence of acid and electrolytic action.

Connections must be kept tight by annually checking with the socket wrenches provided. The reason is that lead is a relatively soft metal and flows slightly under pressure. A periodic checking and tightening compensates for their gradual loosening.

Loose or corroded connections can rob the battery of its proper floating current even though the charger voltage is held at the correct value. In an emergency, when the battery discharges, poor connections can lower the battery voltage, thus robbing vital circuits of the power they need.

7.30 LOW CELLS

With proper floating operation at the recommended voltages and with individual cell temperatures varying not more than 5°F. cell voltages should be within plus or minus .02 volts for antimony and .04 volts for calcium batteries. Under such conditions, the fully charged specific gravity, corrected for level and temperature, will be 1.200 to 1.220.

When individual cells read lower than the above, it is logical to conclude that for some reasons the charging has not been sufficient. Some causes could be as follows:

- (1) Panel voltmeter reading high. This results in a low float. Correct the panel voltmeter.
- (2) Poor intercell or terminal connections. Remove connections, clean contact surfaces, neutralize with soda solution, dry, coat with No-Ox-Id grease and reassemble.
- (3) Variation in charger voltage over a 24 hour period due to variation in the AC supply voltage. This lowers the average 24 hour float voltage.
- (4) Large instantaneous and continuously repeated variations in the connected load which the charger is unable to follow completely. This results in small successive battery discharges and a low average floating voltage. The remedy for (3) and (4) is to increase the charger voltage about .02 per cell. Repeat if after a month or so the average 24 hour floating voltage is still below the recommended values.
- (5) A temperature variation between cells of more than 5°F. The warmer cells drop to a lower voltage because they require more floating current to keep them fully



FIGURE 6
A coating of No-Ox-Id grease on bolts, connectors, and posts reduces corrosion and helps prevent future trouble.

charged. Shield the warm cells from the external heat source affecting them.

- (6) Impurities in electrolyte introduced into the cell as a nut, bolt, washer, etc. which is dissolved by the action of the acid in the electrolyte leaving a foreign contaminant, which increases the rate of internal loss. Other impurities having a similar effect could be nonmetallic in nature such as salt. Have a one pint sample of the electrolyte analyzed by your C & D Batteries representative who will recommend a procedure for correcting the condition.

7.40 TEMPERATURE

The battery is essentially a chemical device and works because of chemical reactions. Heat always speeds up chemical activity; cold slows it down. The normal battery operating temperatures are between 60° and 90° averaging about 75°F. Higher than normal temperature has the following effects on the battery:

1. Increases capacity.
2. Increases internal discharge or local action losses.
3. Lowers cell voltage for a given charge current.
4. Raises charging current for a given charge voltage.
5. Shortens life.

Lower than normal temperatures have the opposite effects. In general, a battery in a cool location will last longer and give less trouble than one in a warm location.

7.50 REPAIRS

In case of accidental damage to the containers or covers of one or more cells after a battery has been installed, consult the nearest C & D Representative.

7.60 TAP CONNECTIONS

Taps for electrical connections should never be put on part of a battery. To do so results either in partial or complete discharge of the group of cells which are furnishing current to the additional connection, or results in overcharging of the untapped cells.

If a lower battery voltage for some circuit is necessary, a separate battery and charger should be provided. If a tap is unavoidable, furnish complete details to your C & D representative who will be glad to advise on the most economical and satisfactory solution to the problem.

7.70 PUTTING INTO STORAGE

The best method for storing a floated stationary type battery in the event that its connected load is to be disconnected temporarily, is to continue to float it at the recommended voltage provided ac is available for the charger. If ac is not available, fill the cells with water to the high level, give an equalizing charge, disconnect the battery terminals or remove any battery fuses. Then as an added precaution to make sure the battery cannot be discharged, open one intercell or interunit connector on each row of cells.

If storage is on open circuit, give it an equalizing charge every six months if possible.

When returning the battery to service, remake all open connections, replace fuses, and give an initial charge.

SWITCHGEAR—CONTROL BATTERIES

Type	Plasticell Antimony	8-Hour Ampere Hours	Finish Charge Rate Amperes	1.210 Sp. Gr. Electrolyte Gals. Per Cell
Plastical Calcium				
AC-5	A-5	10	.5	.14
AC-9	A-9	20	1.0	.25
BC-5	B-5	15	.75	.14
BC-9	B-9	30	1.5	.25
PCK-5	PK-5	40	2.0	.37
PCK-7	PK-7	60	3.0	.35
DCA-7	DA-7	75	3.75	.65
DCA-9	DA-9	100	5.0	.55
DCA-11	DA-11	125	6.25	1.5
DCA-13	DA-13	150	7.5	1.4
DCA-15	DA-15	175	8.75	1.25
DCA-17	DA-17	200	10.0	1.15
PCR-7	PR-7	120	6	1.5
PCR-9	PR-9	160	8	1.4
PCR-11	PR-11	200	10	1.6
PCR-13	PR-13	240	12	2.0
PCR-15	PR-15	280	14	2.9
PCR-17	PR-17	320	16	2.7
PCR-19	PR-19	360	18	2.6
PCR-21	PR-21	400	20	3.5
PCR-23	PR-23	440	22	3.4
PCR-25	PR-25	480	24	4.5
PCR-27	PR-27	520	26	4.2
PCR-29	PR-29	560	28	4.0

SWITCHGEAR—CONTROL BATTERIES

Plactical Calcium	Type Plasticell Antimony	8-Hour Ampere Hours	Finish Charge Rate Amperes	1.210 Sp. Gr. Electrolyte Gals. Per Cell
PCL-9	PL-9	220	11	1.5
PCL-11	PL-11	275	14	1.4
PCL-13	PL-13	330	17	1.6
PCL-15	PL-15	385	19	2.4
PCL-17	PL-17	440	22	2.3
PCL-19	PL-19	495	25	2.2
PCL-21	PL-21	550	28	2.9
PCL-23	PL-23	605	30	2.8
PCL-25	PL-25	660	33	3.5
PCL-27	PL-27	715	36	3.4
PCL-29	PL-29	770	39	3.3
PCF-17	PF-17	880	44	4.2
PCF-19	PF-19	990	50	5.8
PCF-21	PF-21	1100	55	5.4
PCF-23	PF-23	1210	61	7.1
PCF-25	PF-25	1320	66	6.7
PCF-27	PF-27	1430	72	9.3
PCF-29	PF-29	1540	77	8.9
PCF-31	PF-31	1650	83	8.5
Hi Power Types				
PCKT-7	PKT-7	50	2.5	.35
	PKT-13	100	5.0	.6

TELEPHONE BATTERIES

Plastical Calcium	Type Plasticell Antimony	8-Hour Ampere Hours	Finish Charge Rate Amperes	1.210 Sp. Gr. Electrolyte Gals. Per Cell
AAC-6		6	.3	.25
AC-10	A-10	10	.5	.14
AC-20	A-20	20	1.0	.25
BC-15	B-15	15	.75	.14
BC-30	B-30	30	1.5	.25
PCC-50	C-50	50	2.5	.35
PCC-60	C-60	60	3.0	.35
DC-75	D-75	75	3.75	.65
DC-100	D-100	100	5.0	.55
DC-125	D-125	125	6.25	1.5
DC-150	D-150	150	7.5	1.4
DC-175	D-175	175	8.75	1.25
DC-200	D-200	200	10.0	1.15
PCE-180	CE-180	180	9	1.2
PCE-240	CE-240	240	12	1.5
PCE-300	CE-300	300	15	1.8
PCE-360	CE-360	360	18	2.5
PCE-420	CE-420	420	21	2.4
PCE-480	CE-480	480	24	3.1
PCE-540	CE-540	540	27	3.0
PCE-600	CE-600	600	30	3.8
PCE-660	CE-660	660	33	3.7
CF-720	F-720	720	36	5.0
CF-840	F-840	840	42	4.6
CF-960	F-960	960	48	6.2
CF-1080	F-1080	1080	54	5.8
CF-1320	F-1320	1320	66	7.1
CF-1680	F-1680	1680	84	8.9
HI Power Types				
PCKT-50	PKT-50	50	2.5	.35
	PKT-100	100	5.0	.6

BATTERY TYPES (1962)

Telephone		8 Hour Ampere Hours	Finish Rate Amperes	1.210 Sp. Gr. Electrolyte Gals. Per Cell	Switchgear-Control	
PlastiCal Calcium	PlastiCell Antimony				PlastiCal Calcium	PlastiCell Antimony
		170	8	1.2	KCU-5	KU-5
KCT-180	KT-180	180	9	1.3		
		255	13	1.5	KCU-7	KU-7
		270	14	1.5		
KCT-270	KT-270	300	15	2.2		
		340	17	1.4	KCU-9	KU-9
KCT-300	KT-300	360	18	2.0		
		425	21	1.8	KCU-11	KU-11
KCT-360	KT-360	450	23	2.5		
		480	24	3.1		
KCT-450	KT-450	510	25	2.3	KCU-13	KU-13
		540	27	2.9		
KCT-480	KT-480	595	30	2.8	KCU-15	KU-15
		660	33	4.0		
KCT-540	KT-540	680	34	2.7	KCU-17	KU-17
		720	36	3.8		
KCT-660	KT-660	765	38	3.7	KCU-19	KU-19
		840	42	6.5		
KCT-720	KT-720	850	42	3.6	KCU-21	KU-21
		900	45	6.3	LCU-13	LU-13
LCT-840	LT-840	1008	50	6.3		
		1050	52	6.0	LCU-15	LU-15
LCT-1008	LT-1008	1176	59	6.0		
		1200	60	5.8	LCU-17	LU-17
LCT-1176	LT-1176	1344	62	7.1		
		1350	67	5.5	LCU-19	LU-19
LCT-1344	LT-1344	1500	75	6.7	LCU-21	LU-21
		1512	76	8.7		
LCT-1512	LT-1512	1650	83	8.4	LCU-23	LU-23
		1680	84	8.4		
LCT-1680	LT-1680	1800	90	8.1	LCU-25	LU-25
		1950	97	7.9	LCU-27	LU-27

NOTES

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C & D BATTERIES
of Conshohocken, Pa.

DIV. THE ELECTRIC AUTO-LITE CO.

Manufacturers of Slyver-Clad[®] Industrial Batteries
PlastiCell[®] and PlastiCal[®] Batteries for
Communications, Control, and Auxiliary Power
Producers of AutoReg[®] Silicon Chargers and
AutoCal[®] Charger-Battery Combinations

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