PHILCO

Starting Battery Service Manual

PHILADELPHIA STORAGE BATTERY CO.
Ontario and C Streets
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Index

The Importance of Good Merchandise

In our Sales Manual we have told you all about our most unusual and aggressive merchandising and sales plan on Philco Automobile Starting batteries. We told you about our nation-wide, new, different, full-page national advertising; about the liberal discounts to the dealer, trade-in allowance, easy payments and each and every one of the big guns of our campaign against gyp and cheap batteries and for big dollar dealer profits.

But you realize and we realize that the one important thing that is going to make this big, co-operative campaign 100 per cent successful is the fact that this new plan is built around the world-famous Philco Diamond Grid battery—without any question the finest automobile starting battery ever constructed—a battery that will make good on every advertised point and in every advertised detail.

The Unbeatable Combination

Merchandise must always be right for any campaign or any sales effort to be successful. It is a vast satisfaction to you to know that this entire sales plan is backed up by a battery that positively has no equal on the market today. We know that it must also be a satisfaction to you to be able to merchandise the world's finest starting battery and, at the same time, to know that a real progressive and productive sales plan and sales getting advertising campaign are behind it.

Such a combination is not only hard to beat but impossible to beat. That is why we are so absolutely confident that this is going to be by far the biggest Philco year ever known in the history of the battery service station business of America.

Know Your Merchandise

You are probably entirely familiar with the construction of the Philco Diamond Grid battery and the outstanding points of its unquestioned superiority.

However, we are giving you in this Manual the valuable sales points that pertain to the Philco Diamond Grid. No matter how well you know this battery we urgently advise you to read this Manual so there may not be one single point with which you are not fully familiar. The wise merchant is one who thoroughly understands his merchandise.

We realize that a discussion of the purely mechanical details of storage batteries or any other mechanical device is frequently monotonous. We know that you—in fact, all of us—would rather talk about the money we are going to make and when we are going to get it. We have tried to tell you all this as accurately and still as enthusiastically as possible.

Now we are coming to the construction of the Philco Diamond Grid battery. We must go into it because we must know our merchandise and recognize its superior merits in complete detail.

Again we urge you to read carefully the following pages in this Manual because our engineers spent years in developing this battery, and unless we spend the necessary time in learning this battery none of us will fully cash in on this very profitable sales plan now about to start.

So let us take the tiresome reading with the pleasant reading and get the full job finished and be ready for a big money year.

Exclusive Features of the World's Best Automotive Starting Battery

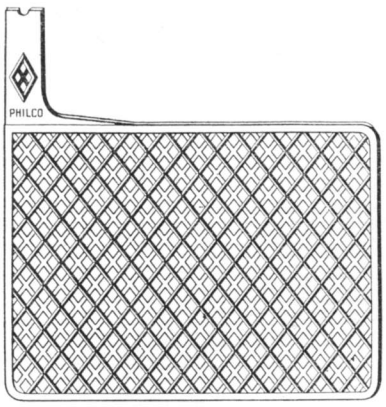
Why Diamond Grid Plates are Famous

The Philco Diamond Grid battery is recognized—even by many of our competitors—as the longest lasting automobile starting battery ever built. This is true. It *is* the longest lasting battery ever built and largely because of Diamond Grid plates.

It is these remarkable Diamond Grid plates that give the Philco Diamond Grid battery its unusual dependability, its tremendous superpower that stands up under steady, gruelling, day-in and day-out driving.

You probably know that every time a car owner steps on the starter, every mile he drives

on the road, the plates in his storage battery are subjected to great strain. This strain comes from road shocks and from the violent chemical action due to heavy charging and discharging.



No. 1 The Diamond Grid

Diamond Grid plates are braced in every direction against strain. Diamond Construction is always used where maximum strength is absolutely necessary. You see it on steel bridges, trestles, derricks, cranes and heavy scaffoldings.

Remember, also, that the framework of the Philco Diamond Grid is double latticed. This locks the power-producing material in the plates and keeps it there. This is a very important feature.

Philco Slotted Rubber Retainer

This retainer is one of the greatest developments in battery engineering.

The life of the plates in a storage battery, therefore the life of the battery itself, depends largely on the length of time the active, power-producing chemical is held in the grids.

As the battery grows older, this power-producing chemical tends to slough off, due to jolting and to chemical processes going on within the plates during charging and discharging.

To hold this vital material fast in the grids and thus prolong the battery life was the problem that long confronted battery engineers.

It remained for Philco engineers to find the answer. Philco battery engineers found the solution of this problem in the perfecting of a retaining wall, a device that holds the solid, active material in the grids yet lets the electrolyte and current through freely.

They first experimented with a rubber sheet pierced with holes, Illustration No. 2, but they found that when the holes were large enough to admit free passage of electrolyte and current, therefore maximum power, the solids (active material) also passed through. This method was therefore immediately discarded.

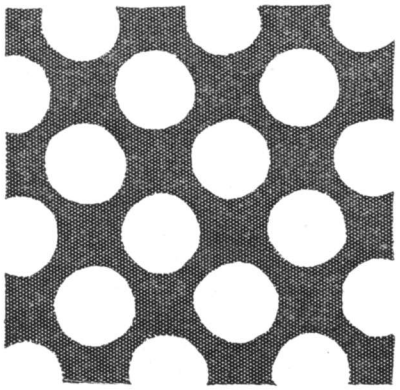


ILLUSTRATION NO. 2

Laboratory experiments continued, and then our engineers **discovered the slot.** This slot —the ideal shape for holding solids back and letting liquids through—is the big secret of the long life of Philco Rubber Retainers.

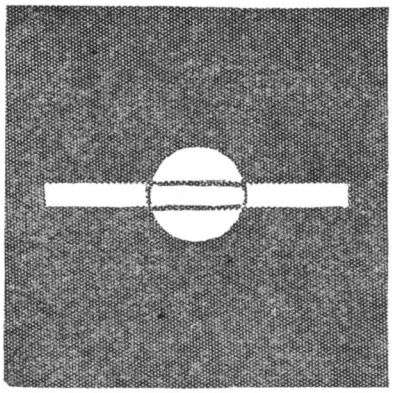


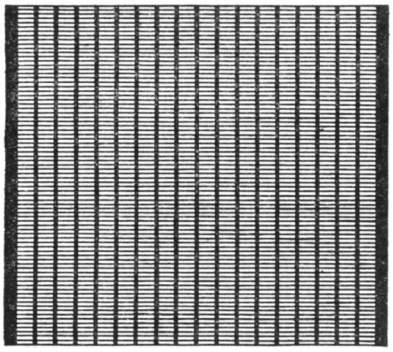
ILLUSTRATION NO. 3

A slot opening, like the one in Illustration No. 3 above, allows the same amount of electrolyte to pass through as a round hole, yet is practically impassable to particles of active material.

The problem of how to prolong the life of plates, therefore the life of a battery, was

solved at last through the slotted retainer, a slotted sheet of hard rubber.

The slots are so numerous in the Philco Retainer that they give free, unobstructed passage to current and electrolyte, yet so narrow that they retain the solid, active material on the plates. For that reason they prevent plate disintegration, and by actual test have been found to prolong battery life 41 per cent.



No. 4. The Philco Retainer (Patented)

It is not surprising, therefore, that the Philco battery, with this and other sound engineering developments, gives years of dependable trouble-free service.

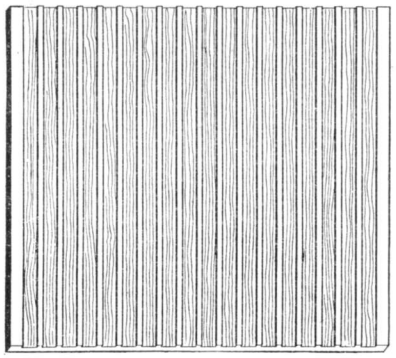
The Philco Slotted Rubber Retainer is one of the biggest factors. It holds solids in the grid and therefore keeps the plates in constant operating condition.

Philco Quarter-Sawed Hardwood Separators

It is generally admitted that Philco Quarter-Sawed Hardwood Separators, used in all Philco "Dry Seal Batteries," and made only from giant trees, thousands of years old, represent the finest type of diaphragm insulation ever included in the construction of a storage battery.

They are quarter-sawed to produce an alternate porous and hard grain. The porous or soft grain of the wood permits circulation of electrolyte and current. This means quick delivery of power. And you know that the quick starting of the engine gives the car owner the same satisfied feeling that he gets from his car when it picks up speed quickly.

The hard or resinous grain is absolutely unaffected by the action of the electrolyte, and furthermore, it protects the porous layers lying between and keeps the plates apart longer than any other known kind of diaphragm insulation, including rubber and cotton types.



No. 5. The Quarter-Sawed Hardwood Separator

The annoyance and expense of frequent battery reinsulation is positively avoided even in the lower-price types of Diamond Grid batteries.

The Quarter-Sawed Hardwood Separator is patented by the Philadelphia Storage Battery Company and is used in all Philco Dry Seal batteries.

Philco Filler Cap

Our engineers thought of you as well as the needs of the car owner. One of the greatest aids to the battery service station is the Philco Filler Cap, Illustration No. 6, which permits removal with only a quarter turn.

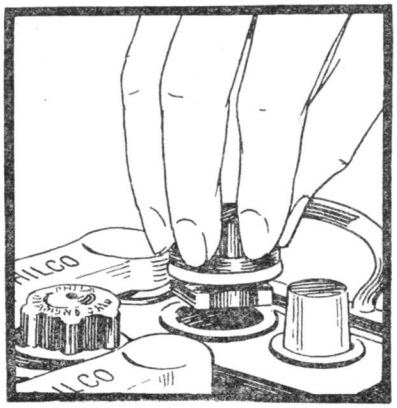


ILLUSTRATION NO. 6

The service station operator, often compelled to use a pair of pliers and often skinning his knuckles in removing the ordinary filler cap from the ordinary battery, will be much pleased at the convenience offered by this bayonet filler cap.

Furthermore, it eliminates the necessity of removing the filler cap from the top of the cell when the battery is on charge on your charging bench. Vents are provided to allow all of the gas to escape even with the cap tightly in place in the cell cover.

Attractive Hard Rubber Case Strong and Durable

The Philco Hard Rubber Case combines beauty with the utmost in strength and durability.

This case will positively stand more pelting with stones, mud and gravel than any wooden case. The Philco Rubber Case is an absolute necessity on cars having an unprotected battery compartment.

Philco Drynamic Batteries

Philco Drynamic Batteries give you a wonderful sales appeal. The car owner can see that he is certain to get the **full life** of his battery because the life of a Philco Drynamic battery doesn't start until he buys the battery and you pour in the electrolyte. **He cannot get a stale Drynamic Philco.**

Experience has proven our prediction made over three years ago that the Philco Drynamic battery would revolutionize the storage battery business. Here are the reasons:

1. Plate for plate, the Philco Drynamic battery is the most powerful battery ever built, surpassing in this regard even our own dry seal types.
2. The battery, being Drynamic (dry-charged), can be handled on a shelf-goods basis and put into service without initial charging merely by adding electrolyte.
3. Its life is as long or longer than any other battery we have ever built before, and Philco batteries have always been noted for their endurance.

Construction and Description of the Wonderful Philco Drynamic Battery

The development of the Philco Drynamic Starting battery covered a long period; subjected to many service tests and in thousands of cars. The development consisted of three parts, namely, the commercial production of a satisfactory dry-charged negative plate, the development of the right character of positive plate and the production of a suitable dry separator for use with dry-charged plates.

We completed the development of a commercial process of making dry-charged negatives years ago, and the first dry-charged battery placed on the American market was the Philco type RB Radio "B" battery. This battery was put out in May, 1922, and two months later volume production of Philco Drynamic batteries was started.

The commercial production of a suitable ribbed rubber separator was an exceedingly difficult problem. So much so that when it was first proposed the hard rubber experts all threw up their hands and said that to make a separator of the kind we specified was quite impractical.

Our engineers, however, did not throw up their hands. We had seen the impossible achieved more than once in our previous experience and were not discouraged. With persistent effort and at great development expense, the hoped-for result was finally and completely achieved, and now the desired one-piece ribbed separators of unadulterated hard rubber were produced on a large scale.

Negative Plates

A negative plate, at the end of formation, consists chiefly of sponge lead. Therefore, when an ordinary plate is dried by the ordinary method, the sponge lead combines with oxygen of the air, forming an oxide of lead; but Philco negatives, being dry charged, are not subject to this trouble.

Various processes have been proposed for keeping formed negative plates in the spongy

lead condition until dry, then, of course, they would no longer oxidize upon exposure to dry air. Some processes that were suggested worked in the laboratory but were uneconomical or unsuited to commercial production. It was not until the Philco method of dry-charging was introduced that this problem was solved.

Positive Plates

Positive plates, at the end of formation, contain chiefly lead peroxide and may be washed and dried by ordinary methods without chemical change. In other words, they do not lose their charge when dried. However, the ordinary positive plate does not have active material of the right character for use in a dry-charged starting battery.

It was here that the improved Philco Process Positive Plate stepped in to do its bit. Philco Process Positives have been found to be of just the right character for use with ribbed rubber separators in the Drynamic starting battery.

The Secret of Philco Long Life and Power

Perhaps you have wondered how Philco can make batteries which have such long life and yet are so powerful. You know that the ordinary hard positive battery plate gives long life, but is so dense that it lacks power. And you know that the ordinary soft positive plate gives good power but has a short life.

Philco combines extraordinary power with extraordinary life by the simple, but exclusive, patented Philco process. In the Philco process the freshly pasted plates are put in a huge cylinder which is then filled with superheated steam. The superheated steam sets the paste almost instantly, so that it has no time to shrink and crack as in ordinary slow-drying processes. You know how mud which dries out slowly in the sun develops cracks. **The Philco Process absolutely prevents any cracking whatsoever.** Look at any Philco plate through a magnifying glass and see for yourself.

Naturally, paste that is set instantaneously and without cracking and shrinking makes better contact with the supporting grid and thus gives much longer life. **It gives greater power as well.** And here is the reason:

The water in the original paste is instantly changed into steam by the superheated steam, and the pores which are left when the steam flows out are permanently set in the paste ready for the acid to flow in as the acid is poured into the finished battery.

You can readily see how much more porous a Philco process plate is than a plate which has been slowly dried. While a plate is drying slowly, the paste is shrinking in on itself at one spot and cracking at another spot. This never happens to a Philco plate.

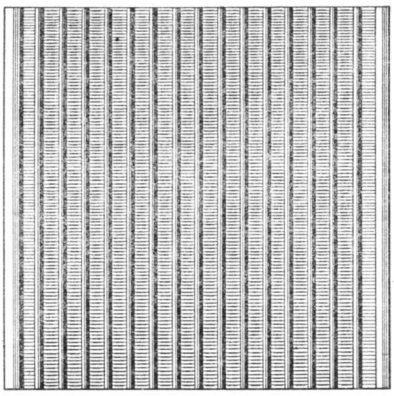
The Value of Fewer and Thicker Plates

The Philco process gives Philco batteries still another advantage. It permits of the use of thicker plates. You know that thick plates give longer life and less trouble than thin plates. The only object in using thin plates is to get more of them in a given size battery to allow the acid to come in contact with more active material. But thin plates shorten the life of a battery.

How much better it is to let the acid come in contact with more active material by making the plates uniformly porous throughout, like Philco does, by using the Philco process. Then very thin plates become completely unnecessary. Instead of having to use thirteen very thin plates to get enough starting power, Philco gets more than enough starting power from eleven thicker but more porous Philco process plates, and of course very much longer life.

Philco Ribbed Rubber Separators

These ribbed, hard rubber separators positively and permanently keep the plates apart. Plate contact—a serious defect—is one of the big troubles met with in cheaply built batteries. There are thousands of slots in the Philco Hard Rubber Separators for free circulation of electrolyte and current, and quick delivery of power, yet these slots are narrow enough to prevent the active material passing through. These ribbed separators are made in one piece out of high-grade rubber compound and **contain no cotton threads or other soluble material.** They have vertical acid-proof ribs every $\frac{5}{16}$ of an inch.



No. 7. Philco Ribbed Rubber Separator (Patented)
(Used only in Philco Drynamic Batteries)

IMPORTANT: Philco **Drynamic** batteries are the only batteries made with no power-restricting diaphragms between the plates.

The elimination of diaphragms, of course, increases the power of the battery tremendously. This is a big selling point.

Advantages to the Dealer

The advantages of the Philco Drynamic Starting battery to the dealer should not require much explanation. There is absolutely nothing in this battery to deteriorate. Even if a battery is kept in stock for several years it will hold its charge and a few minutes after filling will do its work just as well as a new battery.

Philco dry-charged plates are stable in ordinary dry air. However, when the air is very humid, as in summer or when batteries are shipped by boat, moisture is absorbed by the plates. To prevent this we have thoroughly sealed the cells. Each vent cap has a bubble moulded on the top which seals the opening in this cap. **These bubbles must be cut or broken from the cap before the battery is put into service.** Make sure that there is a hole at least one-sixteenth inch in diameter through the cap when this bubble is removed.

The dealer will readily appreciate the advantage of being able to make immediate delivery even including odd types of batteries. Many sales are lost—of standard types as well as of odd types—because the prospective customer is told that he must wait until the battery is given an initial charge.

The saving in charging equipment, rental batteries, space and electric current is, of course, greatly in favor of the handling of Drynamic batteries, and where a dealer already has sufficient charging capacity, rental batteries and space, Philco Drynamic batteries enable him to greatly expand his business without making any additional investment.

The electrical characteristics of a Philco Drynamic battery, before any charge has been given, depend largely upon the time that has elapsed since the electrolyte was poured in the cells. It takes only a few minutes for the acid to work well into the plates and separators.

Ordinarily, a Drynamic battery will develop plenty of voltage to start an engine after the plates have soaked in the acid fifteen minutes, which is about the time usually required for removing the old battery, preparing the compartment, installing the filled battery, cleaning and attaching the terminals, tightening the holddowns and replacing the floor boards or cushion. Longer soaking, up to a maximum of two hours, improves the starting ability.

Installing the Battery

It is obvious that the first thing to do when a sale is made is to make sure that the bubble on the vent cap is broken, and that there is a hole at least one-sixteenth of an inch in diameter through the cap when this bubble is removed. Then fill the battery with electrolyte of the proper specific gravity. The battery will then have the benefit of the longest possible soaking period while other things are being attended to. Usually, the engine will be warm when a customer comes for a battery. If the engine is cold or if it is known to be an exceptionally hard-starting engine, it is advisable to allow the battery to soak for at least thirty minutes before drawing any current from it.

After the engine has been started the first time with a newly-filled battery and the car is driven away, the starting power of the battery will rapidly become still better, owing to the charging and shaking given it by the operation of the car.

After a few days' use in a car, which is delivering sufficient charging current to the battery, the electrical characteristics will be better than those of the old type of battery which requires the long initial charge.

Our tests indicate that the Philco Dry-

namic battery is the most powerful Starting battery ever built, surpassing in this regard even our former types.

Even though a newly installed Drynamic battery starts the engine with surprising vigor and vim, it must be remembered that the battery is still only partially charged. The car generator must complete the charge. Therefore, it is well for the dealer to check the charging rate of the generator and set it up, if it is too low.

The power and pep of a new Drynamic may seem amazing, considering that the plates have had no initial charge whatever, but the power after the generator has completed the charge is still greater; in fact, as indicated above, greater than we have ever seen in any equivalent size battery.

Advantage to the Car Owner

To the user, the Philco Drynamic Starting battery has the outstanding advantage that the life of the battery does not start until the day he buys it—the day the electrolyte solution is poured in. He is sure to get the **full** life of his battery.

It will have better life, not only for this reason but because the separators are mechanically very strong and less likely to be injured than previous wood or rubber separators. They are also much less likely to be cut through by pressure or abrasion of the plates in service. But the main advantage to the user is the still greater security against hand cranking resulting from the super-power of a Philco Drynamic battery.

Putting Drynamic Batteries into Service

Philco Drynamic batteries may be put into service without any initial charging as follows:

Remove the seal from the top of each filler cap. Fill each cell to the bottom of the filling well or about ¾ inch above the separators with pure sulphuric acid electrolyte having a specific gravity of 1.275 to 1.285 at 80° F. This electrolyte must be of an approved grade for storage battery use. See list of approved manufacturers on third cover page.

We advise that if you are not already purchasing electrolyte from one of these manufacturers that you do so in the future. In ordering acid or electrolyte from any of these companies, specify "To be in accordance with Philadelphia Storage Battery Company Specification."

The battery will develop sufficient voltage to start an engine in about fifteen minutes after filling under usual conditions. This is about the time ordinarily required for preparing the compartment, installing the filled battery, cleaning and attaching terminals, tightening holddowns and replacing floor boards or cushion. Longer soaking, up to two hours, will improve the starting ability of the battery. Do not soak longer than two hours.

Open-circuit voltage readings of the cells during the soaking period give an indication of how quickly the electrolyte is working into the plates. If any cell reads less than two volts on open circuit fifteen minutes after filling it is possible that the battery will not break away a hard-starting engine at this time. Five to ten minutes additional soaking may be needed in such a case.

If it is desired to get the full rated capacity and the full power that this battery is capable of delivering right from the start, it can be gotten by giving the battery a freshening or initial charge before putting it into service. After filling, allow the battery to soak two hours, then charge for not more than fifteen hours at the rate specified in Table No. 1 below or at a lower rate, such that the cell temper-

Normal Initial Charge Rates

Plates per Cell	Type SR	Type MR MX	Type LR	Type GCR	Sp. Gr. of Acid for Initial Filling
7	2.0	1.5	...	...	1.275 to 1.285
9	2.5	2.5	...	...	1.275 to 1.285
11	3.5	3.0	...	...	1.275 to 1.285
13	4.0	3.5	...	...	1.275 to 1.285
15	4.5	4.0	...	...	1.275 to 1.285
17	5.5	5.0	...	6.0	1.275 to 1.285
19	6.0	5.5	4.5	...	1.275 to 1.285

TABLE NO. 1

ature does not exceed 110° F. Do not give this initial freshening charge with a Constant Potential charging set unless sufficient resistance is inserted in each battery circuit to bring the rate down to the values given in Table No. 1. The rates given in Table No. 1 positively must never be exceeded.

The fully charged specific gravity of the electrolyte in Philco Drynamic batteries should be 1.275 to 1.285.

After giving the batteries this fifteen-hour initial charge, check the specific gravity to make sure that they have been filled and charged correctly.

The Philco Dry Seal Battery

The term "Dry Seal" describes the patented method of assembling Philco batteries, a method that guarantees no deterioration during the period they are in transit and stock at the service station.

Method of Preparation

1. Positive plates bone-dry.
2. Negative plates impregnated with moisture.
3. Specially treated patented quarter-sawed hardwood separators impregnated with moisture.

The battery is completely assembled in the usual manner and each cell is then hermetically sealed.

As no acid is used in the preparation of Philco "Dry Seal" batteries, there is no deterioration of plates, separators or appearance before the battery is finally put into service by the service station.

The Philco Retainer Type

Philco Diamond Grid batteries with Philco Retainers and Quarter-Sawed Hardwood Separators have demonstrated, by long service in every part of the civilized world, their ability to render perfect service at a minimum ultimate cost.

The price is only slightly higher than on common, ordinary types of batteries and they are scientifically designed and built to meet a demand for unfailing service over an unusual period.

Guaranteed for two years, Philco batteries of the retainer type solve the replacement problem permanently on most cars, and it is not difficult to show the average car owner the economy of buying one Philco Retainer battery instead of two ordinary batteries—one battery to last the remaining life of his car.

Furthermore all Retainer batteries are oversize and many car owners who expect to keep their cars only a year or two buy Retainer batteries because of the greater insurance against being stalled on a railroad track or in city traffic. They want a big margin of safety and will pay for it.

The Wood-Insulated Type

Philco Diamond Grid batteries, equipped with patented quarter-sawed hardwood separators, have a most enviable reputation for long, satisfactory service and generally far outlast their one-year guarantee. They appeal to that broad market of thrifty car owners who want a genuine, full-size battery, backed by a liberal guarantee from a nationally known manufacturer, but have not money enough or are not going to keep their cars long enough to warrant their purchase of a Philco Retainer battery.

External Appearance

"Dry Seal" batteries may be kept indefinitely without deterioration. They are dry and clean, and should look as fresh and new after six months in your stock as the day they were unpacked.

Care of Stock

"Dry Seal" batteries should be kept in a clean, dry place, where it is not excessively warm. It is advisable to cover them with paper as a protection against dust, and thus preserve their new appearance.

They require no attention until you are ready to put them into service.

Follow the Instructions

We cannot impress you too strongly with the importance of following the instructions which are attached to each "Dry Seal" battery when putting it into service.

Under no circumstances should "Dry Seal" batteries be put into service without completing the full initial charge.

Don't allow an impatient customer to induce you to "take a chance." The kind of service the battery will give to your customer will depend to no small extent on your co-operation in this particular.

First or Initial Charge

Philco Dry Seal batteries must always be given an initial charge before being put into service. It is very important that this initial charge be given at the rates specified in the following table (Table No. 2) and that the charge is continued until the batteries are fully charged. This will require at least three and one-half days and should be longer than this rather than less. Never attempt to hurry the initial charge by using a higher rate than given in the table.

Remove the filler cap and fill the cells at once with chemically pure sulphuric acid (see list of approved acid manufacturers on third cover page) until the level is even with the bottom of the vent tube in the cover. The correct specific gravity of acid to use for the different types of batteries is given in Table No. 2. Do not fill with acid whose temperature is above 90° F.

Remove the seal from the top of the filler caps, making sure that the vent hole is open. Insert the filler caps in the covers.

Allow the battery to soak from one to two hours and then put on charge at the rate given in Table No. 2. Keep the current at this rate throughout the entire charge.

Continue the charge until the battery voltage and the specific gravity of the electrolyte have ceased to rise as shown by readings taken at four-hour intervals. As mentioned before, this will require from three and one-half to four days of continuous charging.

Watch the cell temperature during the charge and do not allow it to exceed 110° F. If it approaches this point, stop the charge until the battery cools. Extend the charge that much longer if it is necessary to stop the charge for any length of time.

When fully charged the specific gravity of the acid in all cells should be 1.275 to 1.285.

Normal Initial Charge Rates

No. of Plates	Types	Amps.	Sp. Gr. for Acid for Initial Filling	No. of Plates	Types	Amps.	Sp. Gr. for Acid for Initial Filling
5	LM LMR	1.0	1.245	7	LSR	2.0	1.245
7	LM LMR	1.5	1.245	9	LSR	2.5	1.265
9	LM LMR	2.5	1.265	11	LSR	3.5	1.265
11	LM LMR	3.0	1.265	13	LSR	4.0	1.265
13	LM LMR	3.5	1.265	15	LSR	4.5	1.265
15	LM LMR	4.0	1.265	17	LSR	5.5	1.265
17	LM LMR	5.0	1.265	19	LSR	6.0	1.265
19	LM LMR	5.5	1.265	17	GCR	6.0	1.265
				19	LR	4.5	1.265

TABLE NO. 2

Important: Do not give this initial charge with a Constant Potential charging set unless sufficient resistance is inserted in each battery circuit to bring the rate down to the figures given above.

A Good Recharging Business Leads to Many New Battery Sales

Be sure to get the confidence of the car owners in your neighborhood by giving them good service when their batteries need recharging.

Recharging of run-down batteries is a very important as well as a very profitable part of service station work. Although the operation is quite simple, some care must be taken to insure every battery getting the proper charge. The best method of checking the charge is to read the specific gravity of the acid in each

cell at intervals of several hours towards the end of the charge.

A number of batteries cannot be put on charge at the same time and brought up to full charge together even though all of the gravities when discharged were about the same. The amount of charge required will depend to a certain extent on what made the gravities low.

A battery that drops in gravity to 1.075 just by standing idle for many months will need a lot more charge than one that was run down to 1.075 by a continuous discharge. Other factors also will vary the amount of charge required so that it is necessary to check the specific gravity of each cell at least twice towards the end of the charge to determine whether or not the gravity has stopped rising. Another common trouble that this will catch is acid of too high gravity. If but one gravity reading is taken towards the end of the charge and the gravity is up to 1.285, it would look as though the battery was fully charged and very likely the charge would be stopped. In this case, if the charge would be continued and a second gravity reading taken two hours later, it would be noticed that the gravity was still coming up and the battery could be left on until no further increase was noted. All gravities that come above 1.285 should be adjusted as explained on page 11.

Always examine each cell of every battery soon after it is put on charge to see if any water is needed. If necessary, add pure distilled water to all cells in which the level is low. Add this water while the battery is on charge so that the gassing of the battery will mix the water with the acid.

High-Rate Test Discharge

Many service stations today are giving each battery that is taken off a car a high-rate test discharge in order to determine as much as possible about its condition. The usual equipment used for this discharge test is a variable resistance, often made up of carbon blocks, upon which the pressure can be varied, an ammeter which is connected in series with the variable resistance to show the rate of discharge and a voltmeter which can be connected across each cell in turn by means of a pair of prods to read the individual cell voltage.

The rates given in the following table (Table No. 3) will be found satisfactory for this test:

No. of Plates	Types	Test Discharge Rate In Amperes	No. of Plates	Types	Test Discharge Rate In Amperes
5	MR, MX, LM	80	5	SR, LSR	88
7	MR, MX, LM	120	7	SR, LSR	132
9	MR, MX, LM	160	9	SR, LSR	176
11	MR, MX, LM	200	11	SR, LSR	220
13	MR, MX, LM	240	13	SR, LSR	264
15	MR, MX, LM	280	15	SR, LSR	308
17	MR, MX, LM	320	17	SR, LSR	352
19	MR, MX, LM	360	19	SR, LSR	396

TABLE NO. 3

Connect the battery to the testing machine and adjust the variable resistance to the proper rate as determined from Table No. 3. Holding the current at this rate, read the voltage of each cell by means of a pair of prods connected to the voltmeter. The cell voltage will depend entirely on the condition of the battery. Even though the battery is almost completely discharged, all the cells of the battery, unless there is some trouble, will read about the same. If two cells each give a reading of say 1.60 volts, while the third cell shows almost no voltage, you can feel quite sure that there is some trouble with the one cell. This cell should

not be opened up for examination, however, until after you have attempted to bring the battery up to full charge.

Charge the battery at the correct rate until there is no further increase in the specific gravity of the electrolyte and then repeat the high-rate test discharge. With the battery fully charged, it may be necessary to keep this discharge on for one-half minute to a minute in order to show up the low cell. Never open up a battery to make repairs on it unless you have first tried to correct the trouble by a prolonged overcharge at the initial charge rate. Many times batteries are opened for an examination when the only thing that was required was an overcharge at the initial charge rate. This may be the case even when it is just one cell out of three that is low.

Mixing Acid

A service station handling both Drynamic and Dry Seal batteries will need several different gravities of acid for the initial filling of these batteries so that it would probably be best to buy acid of 1.400 specific gravity. This can then be reduced by mixing with pure water to whatever gravity is needed.

When mixing the acid always pour the acid into the water. This will prevent dangerous splashing. Add the acid very slowly and keep stirring with a clean piece of wood to insure thorough mixing. If the electrolyte becomes warm allow it to cool to room temperature before using. Specific gravity readings are dependent on temperature and are based herein on a temperature of 80° F. If the acid temperature varies considerably above or below this temperature, the specific gravity readings as taken should be corrected as follows:

Temp. 110°F. Add .010 to specific gravity reading
Temp. 100°F. Add .007 to specific gravity reading
Temp. 90°F. Add .003 to specific gravity reading
Temp. 80°F. No correction
Temp. 70°F. Subtract .003 from specific gravity reading
Temp. 60°F. Subtract .007 from specific gravity reading
Temp. 50°F. Subtract .010 from specific gravity reading

Be sure that the correct gravity acid is used for the initial filling of all batteries (see Tables Nos. 1 and 2).

Caution. Never use any electrolyte or solution of any kind either for the initial filling of Philco batteries or to replace solution which has been removed later in the life of the battery, except sulphuric acid of the proper gravity and purity.

Adjusting Acid Gravities

Never add acid to a battery under ordinary conditions. The capacity and life of batteries are often reduced by the improper addition of acid. The acid in a battery cannot evaporate, only the water evaporates. Therefore, if no acid has leaked or splashed out or has been boiled out on charge and the specific gravity is low, the acid must be in the plates in the form of sulphate and the specific gravity must be restored to the proper point by a long overcharge at the initial charge rate.

If the specific gravity of the acid in one cell is lower than the others after this charge it is due to overfilling, leakage or to some abnormal condition in the cell, such as a leaky jar, impurities in the acid or a short circuit. The first thing to do is to correct the cause of the trouble. This done, the battery must be given an overcharge at the initial charge rate until the specific gravity has reached a maximum. If at this time the cell that was in trouble has a gravity reading of less than 1.275, some acid may be withdrawn from the cell and replaced with 1.350 acid.

Do not add acid at any other time and never use vitriol or any acid stronger than 1.350 specific gravity.

If the acid gravity in any cell rises higher than 1.285, it should be immediately adjusted. In this case, withdraw some acid from the cell and replace it with water. Always adjust acid gravities while the battery is charging so that the electrolyte will be stirred and mixed by the gases evolved.

Dope Electrolytes

There are some "dope" electrolytes on the market that are supposed to rejuvenate worn-out and run-down batteries. We have made investigations of practically all of these solutions and our analysis shows that they are either nothing but sulphuric acid which, if added to a battery, would bring the gravity up so high after a normal charge that it would be ruined, or else sulphuric acid with various percentages of salts, such as sodium sulphate, magnesium sulphate, sodium phosphate and the like. In some instances the percentage of iron, chlorine and other impurities has been high.

The danger in the use of such electrolytes is that in order to get the results mentioned above it is necessary to add the solution when the battery is in a discharged condition and when it becomes fully charged the acid gravity will invariably be higher than it should be. High gravity acid in a battery affects both plates and separators. The wood separators are softened and rotted so that they soon break down and cease to act as insulators. The positive plates are softened and disintegrated. The negative plates are softened and reduced in capacity.

We feel sure that none of our service stations could be talked into buying a "gold brick," figuratively speaking, these "dope" electrolytes are nothing more than "gold bricks" and if you will remember that you are paying anywhere from two to six dollars a gallon for solutions which do not cost, if made from the purest acid, more than 35 cents per gallon or, if made from ordinary commercial acid, not more than 7 cents per gallon, you will easily see how the "dope" manufacturer is using you for an easy mark.

Rental Batteries

In order that the rental battery may give full service it must perform its work perfectly and bring your customer back to your door in a contented and even pleased frame of mind.

In order that you may be well equipped to render this important service, we will furnish new Philco Diamond Grid batteries of either the retainer or wood-insulated type, painted red and branded **Rental** at a cost lower than your regular price. We sell these Rental batteries to our dealers in order to give the fullest possible co-operation and service.

Rental batteries will be sold under the following conditions only:

1. Every purchaser must sign an agreement not to sell Rental batteries.
2. Rental batteries to be composed of new material, but in consideration of the lower prices offered, we will reserve the right to use plates which are slightly imperfect or to use molded covers with screw filler caps if necessary.
3. Rental batteries will be furnished in any current types.
4. Rental batteries are, of course, not covered by the guarantee.
5. Orders must pass through our Branch Office nearest you or your jobber and be O.K.'d. We reserve the right at all times to limit or refuse orders for Rental batteries.
6. All shipments of Rental batteries are made C. O. D.

Free Repair Policy

We will supply to any authorized Philco dealer or service station, free-of-charge, f. o. b. factory or depot, the necessary material for the replacement of any part that may prove defective in a new Philco battery, within ninety days after purchase by the car owner, provided the purchase date is within a reasonable time after the branded date on the battery and subject to the following conditions:

1. The service station will properly install the material, delivering the battery to the customer in good order, making no charge for material or labor.
2. We reserve the right to require the service station to return any parts claimed to be defective, transportation prepaid to factory or depot, for inspection.
3. When the service station makes a request for free replacement of parts the request must be in writing, and give clearly the following information:

Type
Serial Number
Brand
Date of Purchase by Car Owner
Nature of the Trouble

You can readily understand that we cannot allow a credit to the service station for labor, sealing compound, acid or current under this FREE repair policy inasmuch as we supply—free of charge—the necessary material for the replacement.

The Ironclad Guarantee Covering Philco Batteries

Guarantee Period:
- Philco Retainer types, two years
- Wood Insulated and MX Drynamic types, one year
- Special and Bar Grid types, 90 days warranty against defective material and workmanship

When the Guarantee Begins

The guarantee period shall begin with the date of sale to the car owner.

Conditions

1. In case of failure to deliver 80 per cent of its rated capacity the battery shall be subject to adjustment, and the Philco service station which sold the battery, or the Philadelphia Storage Battery Company itself, will fulfill the guarantee by allowing the car owner, on the purchase of a Philco replacement battery of the same type, a reduction from the regular consumer price, proportional to the number of months by which the original battery failed to give (one year or two years' service).

In other words, if a car owner should pay $20 for a Two-Year Guaranteed Philco and it should go bad at the end of one year he would be entitled to buy another battery of the same type for $10.

2. This guarantee covers all ordinary wear and tear but does not cover failure due to accident, neglect or abuse.

3. The car owner shall keep the battery properly charged and properly supplied with distilled water, and shall keep the electrical system on the car in correct operating condition.

4. In case of an adjustment, the old battery shall become the property of the party making the adjustment with the owner.

5. The owner is urged to avail himself of the regular FREE inspection service, and of the excellent facilities for recharging and repairing offered at moderate cost by authorized Philco service stations.

Guarantee Adjustment Policy

You should make prompt and cheerful adjustments, when the customer has a just claim under the guarantee. Don't tell the customer that you will send his battery to the factory or depot, but make adjustment out of your own stock in conformance to the guarantee. Then report the transaction to your jobber or to the Philco Sales Office in your territory.

If the car owner goes for adjustment to the service station from whom he bought the battery, as he usually will, the old battery may be returned to our nearest authorized jobber or depot by the service station, transportation prepaid.

Send at the same time a letter stating the adjustment made, the date on which the battery was sold, the serial number and type, the nature of the trouble, the route by which the old battery is being returned and whether a replacement battery or a credit is desired by you.

The jobber or our depot will ship a replacement battery at ninety per cent of the proper car owner adjustment price, f. o. b. jobber's stock or our depot, or will credit the service station with the amount if his regular price is greater than ninety per cent of the car owner adjustment price.

We make the price to you ninety per cent of the adjustment price to protect you from any loss and to pay your expenses in handling adjustments.

It will sometimes be to your advantage to adjust with the car owner, keep the old battery and not demand an adjustment from us, for in the latter months of the guarantee you can

make a profit above your new battery cost even when selling at the adjustment price.

When a profit can be made on an adjustment the profit is yours, but when a loss is incurred you can pass the burden to us.

If the car owner ships a battery direct to our depot or factory for adjustment, we will ship a new battery, express C. O. D., or by freight—sight draft attached to bill-of-lading, at the proper adjustment price, f. o. b. our factory or depot.

The car owner must pay transportation charges, however, both on the old battery and the replacement battery, and if the old battery is returned transportation charges collect, the same shall be added to the adjustment price on the replacement battery.

The Philco guarantee is acknowledged to be one of the most fair, most practical and most workable Starting battery guarantees ever written. And all car owners and all Philco dealers know that the Philadelphia Storage Battery Company lives up to every letter and word of it. You can always depend upon our utmost co-operation at all times.

What Every Service Station Wants to Know About Charging

Many Service Station operators are confused by the conflicting claims made by the manufacturers of different kinds of charging equipment. We thought that every Service Station would appreciate it if we devoted an entire section of this manual to a discussion of the advantages and limitations of each kind and method of charging.

There are four general methods of charging S.L.I. batteries:

Constant Potential

The prime object of Constant Potential charging is to give quicker charging service and thereby attract customers. This is a very worthy object, because if you can get car owners in the habit of coming to you when in need of recharging or repairs and by good service win their confidence, you will surely sell renewal batteries to a large percentage of them sooner or later.

However, the dangers of Constant Potential charging are so great that it is today being supplanted by other methods.

The success of Constant Potential charging depends, first, upon the equipment purchased, and, second, upon the intelligence and care exercised in the use of the equipment. The possible danger lies in believing that such charging is automatic and requires little or no supervision.

It stands to reason and is confirmed by experience that not less but more supervision is required when batteries are charged rapidly at high current rates as is done in Constant Potential charging than when they are charged slowly in the old way. Battery temperatures, in particular, must be watched closely and specific gravities should be observed frequently. Also, considerable judgment is needed in regard to placing batteries on charge because it is very easy to overload the machine and blow fuses by starting the charge of a number of discharged batteries at one time.

We are opposed to 8-hour charging by present Constant Potential method on account of the very close supervision required to make it safe. Charging in 16 to 20 hours by some other method achieves the same result, namely, that the customer can get his battery the next day. Such charging is much safer and more certain to give the customer satisfaction. When customers become aware of the possibilities for harm in the so-called 8-hour Constant Potential charging, they will patronize the service stations which advertise the saner 16-hour charging service.

We do not recommend Constant Potential charging for bringing up new batteries which have been shipped unfilled. Regardless of the kind of separators used, new plates are apt to suffer an insidious injury by a high current rate during the initial charge, an injury which may not be apparent at once but which is more than likely to shorten the life of the battery. Neither can we recommend Constant Potential charging for badly sulphated batteries or repaired batteries in which plate replacements have been made.

Modified Constant Potential

It is our belief that Constant Potential charging of automotive batteries will follow the same course of evolution that has been followed in electric vehicle battery charging and eventually will come around to what is known as Modified Constant Potential charging. This means that the charging bus voltage will be run higher, probably at about 16 volts, and a small amount of fixed resistance, perhaps taking the form of the battery leads, will be used in each individual battery circuit.

This will waste a very small amount of current but will reduce the initial rate of charge and make the charging less sensitive to fluctuations in voltage, variations in battery temperature, etc. The cost of the current used in the resistances will thus be cheap insurance against blown fuses and damaged batteries.

Any of the Constant Potential charging sets on the market can be used this way. It is only necessary to increase the bus voltage to about 16 volts for a 6-cell battery and then, as explained above, insert enough resistance in each battery circuit to hold the initial charging current on a totally discharged battery down to a reasonable figure.

Most manufacturers of this type of charging equipment now list separate resistances of some form to be used with their machines. It is necessary to have resistances of several different values in order to take care of the various charging rates required. A very low resistance can be used when charging a normally discharged battery, while a much higher resistance will be necessary in order to cut the rate low enough for the initial charging of new batteries.

See the manufacturer of the charging set for the proper resistance to use and then check the results by actual tests on batteries.

Bulb Rectifiers

Charging by this method proves to be very satisfactory for all sizes of battery service stations. Bulb type rectifiers can be gotten that will charge from one to ten 3-cell batteries in series.

This is one of the safest methods of charging batteries of this type. The charge rate is not high at the beginning of the charge. The batteries do not overheat and they require practically no attention while charging. It is perfectly safe to keep the batteries on charge over night while there is no attendant with them. In some cases a little more time may be required for a charge by this method than if higher rates were used, but the insurance of safety and the little attention required more than make up for the few additional hours charge needed.

Direct Current

Service stations that are in a direct current district and have a 110-volt D.C. line that can be used can do their battery charging under the best possible conditions and at little expense for equipment.

All that is required is a bank of lamp sockets and the charge rate can be controlled by using

Number of 100-Watt Lamps Required for Various Charge Rates for One to Ten 6-Volt Batteries

Number of 6-Volt (3-cell) Batteries in Series	NUMBER OF 100-WATT LAMPS TO USE FOR									
	1 Amp	2 Amps	3 Amps	4 Amps	5 Amps	6 Amps	7 Amps	8 Amps	9 Amps	10 Amps
1	1	2	4	5	6	7	8	9	10	11
2	1	2	4	5	6	7	8	9	10	12
3	1	2	4	5	6	7	9	10	11	12
4	1	3	4	5	6	8	9	10	11	12
5	1	3	4	5	7	8	9	10	12	13
6	2	3	4	6	7	8	10	11	12	14
7	2	3	5	6	7	9	10	12	13	15
8	2	3	5	6	8	10	11	13	14	16
9	2	4	5	7	9	10	12	14	15	17
10	2	4	6	8	10	11	13	15	17	19

Use lamps of same voltage as charging line; for example, if line voltage is 110, use 110-volt lamps; if 120, use 120-volt lamps.

TABLE NO. 5

different numbers of lamps or of fixed resistors which screw into the lamp sockets. The preceding table gives the number of 100-watt lamps required for charging different numbers of batteries connected in series at rates of from 1 to 10 amperes. If the number of lamps given in this table is used, the charge rate will be very close to that given at the top of the different columns.

If desired, fixed resistors equipped with a screw base so that they can be used in standard lamp sockets can be used in place of lamps. Resistors of this type can be obtained in many capacities but a good size to use is one having 75 ohms resistance rated to carry 200 watts continuously. Table No. 6 gives the number of such resistors required to obtain different charge rates on different numbers of batteries.

Number of 75-Ohm Fixed Resistors Required for Various Charge Rates for One to Ten 6-Volt Batteries

Number of 6-Volt (3-cell) Batteries in Series	NUMBER OF 75-OHM FIXED RESISTORS TO USE FOR									
	1 Amp	2 Amps	3 Amps	4 Amps	5 Amps	6 Amps	7 Amps	8 Amps	9 Amps	10 Amps
1	1	2	2	3	3	4	5	6	6	7
2	1	2	2	3	4	4	5	6	7	8
3	1	2	2	3	4	5	5	6	7	8
4	1	2	3	3	4	5	6	7	8	8
5	1	2	3	4	5	5	6	7	8	9
6	1	2	3	4	5	6	7	8	9	10
7	1	2	3	4	6	7	8	9	10	11
8	1	2	3	5	6	7	8	9	10	12
9	1	2	4	5	6	7	9	10	11	13
10	1	3	4	5	7	8	9	11	12	14

Use 75-ohm resistors of 200 watts continuous rating

TABLE NO. 6

The batteries that give years of service without requiring any charging or repairing outside of the car are the batteries that have been given a careful initial charge. The satisfaction that a battery will give can, in many cases, be determined if it is known just how it was prepared for service. A battery that has been treated correctly before being put into service will stand up under much abuse that would ruin a similar battery that was hurriedly or carelessly treated.

Conclusion

In this Manual we have endeavored to tell you everything that you should know and everything you may be interested in knowing regarding Philco Automotive Storage batteries, both Drynamic and Dry Seal.

Possibly there are one or two points that may not be perfectly clear to you. There may be questions you wish to ask or information that you desire that we have neglected to give you.

If so, do not hesitate to write us either direct to the factory in Philadelphia or to your Branch Office. We want you to know that we are always more than glad to hear from you and our Engineering Department will be pleased to reply promptly to any letter requesting any technical information whatsoever.

And finally, do not hesitate to write to our Sales Department if there is any additional information you desire on our new and remarkable Sales and Advertising plan for 1927. We want you to be in a position to take the fullest advantage of this new plan.

This is going to be the greatest year by far that we have ever had. It is going to be the biggest year for you. You know the tremendous value of Philco batteries—the outstanding quality of the merchandise—and you can realize the big volume of business that is going to come and come **at once** from our vast and **different** national advertising and sales appeal to the car owners.

PHILADELPHIA STORAGE BATTERY CO.

Approved Acid Manufacturers

We have made a survey of the sulphuric acid industry of the country. Our specifications have been sent to all acid manufacturers and samples of their product obtained for analysis. The result of this thorough investigation is the following list of manufacturers who have received our approval of their product:

J. T. Baker Chemical Company,
Philipsburg, N. J.

Central Chemical Company,
Chicago, Ill.
Hammond, Ind.
New Orleans, La.
Distributor—Beaver Soap Co., Winnipeg.
Agencies in Manitoba, Saskatchewan and Alberta, Canada.

Detroit Chemical Works,
Detroit, Michigan

E. I. DuPont De Nemours & Co.,
Philadelphia, Pa.

General Chemical Company,
Los Angeles, Calif.
San Francisco, Calif.
Capelton, Canada
Montreal, Canada.
Toronto, Canada
Chicago, Ill.
Baltimore, Md.
Newark, N. J.
Buffalo, N. Y.
New York, N. Y.
Philadelphia, Pa.
Pittsburgh, Pa.
Providence, R. I.

Grasselli Chemical Company,
Birmingham, Ala.
Grasselli, Ala.
New Haven, Conn.
Chicago, Ill.
East Chicago, Ind.
New Orleans, La.
Boston, Mass.
Detroit, Michigan
St. Paul, Minn.
St. Louis, Mo.
Paterson, N. J.
Grasselli, N. J.
Brooklyn, N. Y.
Cincinnati, Ohio
Cleveland, Ohio
Hamilton, Ontario
Toronto, Ontario
Philadelphia, Pa.
Montreal, Quebec
Milwaukee, Wis.
New York, N. Y.

Kalbfleisch Corporation
Waterbury, Conn.
Elizabethport, N. J.
Brooklyn, N. Y.
New York, N. Y.
Erie, Pa.

Chas. Lennig & Co., Inc.,
Philadelphia, Pa.

National Zinc Co., Inc.,
Kansas City, Kansas

Smith Agricultural Chemical Co.,
Columbus, Ohio

Southern Agricultural Chemical Corp.,
Atlanta, Ga.
Copperhill, Tenn.

Texas Chemical Company,
Houston, Texas

United Chemical Company,
Fort Smith, Ark.
Little Rock, Ark.
Wichita, Kansas
Shreveport, La.
Muskogee, Okla.
Oklahoma City, Okla.
Tulsa, Okla.
Dallas, Texas
El Paso, Texas
Fort Worth, Texas
Houston, Texas
San Antonio, Texas
Waco, Texas
Wichita Falls, Texas

We advise that if you are not already purchasing electrolyte from one of these manufacturers that you do so in the future. In ordering acid or electrolyte from any of these companies, specify "To be in accordance with Philadelphia Storage Battery Company Specification."