Experts Study Battery Care

The following report resolves many of the conflicting recommendations on battery maintenance.

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Golf course personnel have been concerned with a number of conflicting recommendations having to do with the care and feeding of golf car batteries. In an effort to reach agreement our company submitted a questionnaire to most battery and battery charger manufacturers consisting of 19 multiple-choice questions. This represents a consolidation of answers received together with our own theory developed after several years of research and field work.

Battery Water Level—When watering the battery it is generally best to add the water near the end of charging or after charging the batteries. During charging, the electrolyte expands and batteries leveled before charging may overflow out of the cell vent during charge. However, the electrolyte level should never be allowed to fall below the top of the separators. If the electrolyte is below the tops of the separators enough water should be added, before charging, to raise the level to the tops of the separators. Water should be added 3/8th of an inch above the plates.

In no case should anything but water be added to batteries in field service. Even though the electrolyte solution overflows and acid is lost do not add additional acid. Under some conditions battery electrolyte can be altered, however, this should only be attempted by thoroughly qualified battery technicians.

Type of Water to be Used—The obvious safe answer is to use distilled water only and do not use a metal container to hold the distilled water—use only glass or plastic containers.

City tap water has been used by many people without difficulty and any water that is potable (drinkable) is probably O.K. However, it should be recognized that certain impurities (notably chlorides and iron compounds) are harmful.

Obtain an analysis of your city water and check same against the recommended maximum allowable impurities in water as shown in Table I (page 48).

Each local telephone office must maintain a large number of stand-by batteries. By telephone company regulation, each office must submit samples of their "local water supply" to a testing laboratory in the East periodically and, as a result of these tests, they are told if the local water supply is approved for use in standby batteries or if they must use distilled water.

We recommend that personnel at any golf course, in order to save testing expense and make certain you are using the right kind of water ,telephone their local telephone office and ask the foreman if they use city water or distilled water in their stand-by batteries. If golf courses will maintain their golf car batteries with the same kind of water used by the local

continued on page 48

BATTERY CARE

continued from page 46

telephone company, they will know they are safe in using the local water.

How to Retard Corrosion—A non-metallic grease is used to retard corrosion on the battery terminal posts and BiCarbonate of Soda is best as a cleaning solvent to remove grime from the top of the batteries. Do not let any of the cleaning solution enter the cells, as the cleaning solution acts to neutralize acid and will weaken the electrolyte solution, thus reducing its effectiveness. There are several different commercial products on the market for this purpose.

Charging of Batteries—When you overcharge a battery some of the lead in the positive grid changes to lead peroxide and the battery can become inoperable due to positive grid disintegration. When you undercharge a battery the problem is one of sulphation. Whenever a cell is discharged below the zero voltage point the polarity is reversed and the battery is beyond repair.

Overcharging used to be more of a problem when ballasted constant-current chargers were in service, but not so today with ferro-resonant taper-type chargers. In fact, some firms recommend today that you should charge your batteries to a point of putting back 130 per cent of what you took out. Too frequently, in order to press a golf car into service when it is needed, to reduce an electric bill or in fear of overcharging, the golf cars are actually being *undercharged* and sulphation results.

Table I—Recommended Allowable Impurities in Water

Impurity	Calculated as	Parts per Million
Color		Clear & White
Suspended matter		Trace
Total Solids		100
Calcium & Magnesium oxides	CaO & MgO	40
Iron	FE	5.0
Ammonia	NH_4	8.0
Organic & volatile Matter		50
Nitrates	NO_3	10
Nitrates	NO_2	5.0
Chloride	CL	5.0

Our current recommendation is the MAC 1555 battery charger, is it takes all of the guess-work out of charging batteries and eliminates any possibility of either over-charging or under-charging the batteries. When a car is not in service the battery charger plug is plugged into the car. As long as the red light indicator is *ON* the car is *NOT* to be used. When the red light goes off the car is fully charged and ready for service.

When not in use, especially during winter months, the charger remains plugged in. The charger comes on automatically when charging is needed and shuts off automatically when not needed. Electricity is used only when the charger is operating. All the owner of the car has to do is add water when needed. The MAC 1555 charger shuts off automatically when the battery reaches 44.0 volts (1,260 specific gravity), a full charge.

When to Charge Batteries — Maximum rounds of golf and maximum battery life are obtained when the batteries are charged while they still retain 50 per cent or more of reserve power.

If a golf car is capable of going 36 holes of golf the batteries should be charged after every 18 holes (leaving 50 per cent reserve power). This car could go 36 holes, but taking it beyond the 18 holes will reduce the over-all life of the batteries by reducing the number of cycles of potential electrical power they contain.

If a golf car is capable of going 72 holes of golf it should be charged after every 36 holes of golf. If the golf car goes the full 72 holes it will use up as much as 1½ cycles of its potential electric power (some battery firms believe a full discharge uses up as much as two full cycles) and if charged after 36 holes it will use up only approximately ½ of a cycle of the potential electrical power.

Since the potential electric power is

continued on page 50

BATTERY CARE

continued from page 48

400 to 600 cycles, we will be conservative in the following example and use 400 cycles as being the normal life of a golf car battery. The chart in Table II will show you when to charge a battery and approximately what life to expect of the battery.

In other words, if you leave 75 per cent reserve in the battery at the time you charge the batteries you use up only ¼ of a cycle. If you leave 50 per cent reserve in the battery at the time you charge the bateries you use up only ½ of a cycle. When you go beyond the recommended 50 per cent reserve you drain your potential electric power at a faster rate. If you leave 25 per cent reserve you use approximately a full cycle and if you go all the way and drain all the power you use up at least 1½ and perhaps as much as two cycles of the approximately 400 cycles of life the battery contains.

While example (A) wil give you 800 rounds of golf in terms of battery life it would be a poor income producer for a golf course as it could only be rented out once a day before having to be taken out of service to charge the batteries and if you go the 2nd round example (B) shows you how you would shorten the battery life. Example (E) will give 1,600 rounds of golf before batteries must be replaced, but this car can only give 2 rounds of income before having to be taken out of service for battery charging.

Cost of Electricity to Recharge—The determining factor is the ampere-hours which must be returned and this is a function of the depth of discharge, which varies with the discharge rate. The cost of recharge is determined by the input current to the battery charger.

If we assume an average discharge rate of 35 amperes, a total of 140 A.H. may be removed from the battery. If we further assume a return of 120% of the previously discharged capacity then 168 A.H. must be returned. The probable average charging voltage is 42 volts, thus 42 x 168 equals 7,056 watt hours consumed in the re-charge. If we further assume a charger conversion efficiency of 65% then 7,056 divided by .65 equals 10855 watt hours to be taken from the AC power line for the recharge. Assuming a power cost of $.025/kilowatt-hour the recharge would cost:

$$\frac{10{,}855 \times \$.025}{1{,}000} = \$.271 \text{ or } 27.1¢$$

If these batteries were charged when they still retained 50 per cent reserve the cost of charging the six 6.3 volt batteries would be only 13.6 cents.

Obviously, each golf car requires slightly different treatment and maintenance and it is highly recommended that you follow the manufacturers' specifications. ●

Table II—Life Expectancy of Battery and When to Charge

	Number of Golfing Holes Golf Car Will Produce Before Batteries Are Discharged	Number of Golfing Holes At Time Golf Car Battery Is Charged	Cycles Of Potential Electric Power Expended	Reserve Left In Battery	Approximate Car Usage (18 Hole Rounds)Before Batteries must Be Replaced	Number Of Charges In Battery Life	Elec. Cost of Charging Batteries
A.	36 holes	18 holes	½ cycle	50%	800	800	13.6 cents
B.	36 holes	36 holes	1½ cycles	0%	532	266	27.1 "
C.	18 holes	9 holes	½ cycle	50%	400	800	13.6 "
D.	18 holes	18 holes	1½ cycles	0%	266	266	27.1 "
E.	72 holes	36 holes	½ cycle	50%	1,600	800	13.6 "
F.	72 holes	72 holes	1½ cycles	0%	1,064	266	27.1 "
G.	108 holes	54 holes	½ cycle	50%	2,400	800	13.6 "
H.	108 holes	108 holes	1½ cycles	0%	1,596	266	27.1 "
I.	108 holes	27 holes	¼ cycle	75%	2,400	1,600	06.8 "
J.	108 holes	18 holes	1/6 cycle	83%	2,400	2,400	04.5 "