

## Power Pole option for 257477BA

The –PP option for the 257477BA Battery Adapter adds a couple of Anderson Power Products “Power Pole” PP15 connectors in the ARES configuration under the normal adapter socket bracket.

Each Power Pole connector is both a male and a female and so an extension cable has exactly the same connector setup on each end. This also means that it's easy to use them to connect to either a load or source of power. They are also designed so that you can mate them by feel and they will not short out or cross connect.

## Battery Capacity

Although 10 “D” cells put out about the same voltage as a car battery they can not be used to start a car or power an IC706MkIIG radio. Battery technology is a high technology area, driven by modern portable devices like cell phones, lap top computers and personal digital assistants. Because of the rapid increase in battery capacity I'll try to give some guidelines that will still be valid a year from now.

## Amp Hour Rating

A normal battery Ampere Hour Rating typically uses a run time of about a day, rounded down to an even 20 hours. So a 100 Amp Hour car battery should supply (100 AH / 20 H =) 5 Amps for 20 hours.

The common Energizer E95 “D” cell is rated as an 18 Amp Hour battery with a load of 25 mA that may match some flashlight service. The data sheet on the energizer.com web page shows about 0.5 Amps for 20 hours of service or 10 Amp Hours capacity using the conventional definition.

If the current draw is doubled to 1 Amp you might think the battery would last 10 hours, but that's not the case. You get less amp hours of capacity. In the case of the E95 at 1 Amp it will last only 4 hours according to the data sheet.

## Internal Resistance

All batteries have some internal resistance. During discharge the terminal voltage will be lower than the internal cell voltage. The spec sheet for the E95 lists the internal resistance of a fresh battery as 0.173 Ohms. So if 10 each E95 “D” cells connected in series and the load is 1 Amp then the open circuit (1.5 \* 10 =) 15 Volts output will be dropped by 1.7 Volts to yield 13.3 Volts. The internal resistance is a function of the battery chemistry, Amp Hour rating, and state of charge.

### Measured Performance in 257477BA

Batteries	Chemistry	Advertised Amp Hours	Opn Ckt Voltage	1 Amp load Voltage	Resistance Ohms
Rayovac LR20	Rechargeable Alkaline	9	15.03	10.5	4.5
Radio Shack 23-519	Rechargeable Ni-MH	4.5	12.9	12.44	0.46
Energizer E95	Primary Alkaline	18 (10 act)	15.64	12.44	3.2

### Measured BA-4386/PRC-25 Equivalents

Battery	Chemistry	Advertised Amp Hours	Opn Ckt Voltage	1 Amp load Voltage	Resistance Ohms
BB-586/U	Rechargeable Ni-Cad	4.0	14.77	13.69	1.08
BA-5598/U	Primary LiSO <sub>2</sub>		14.93	11.6	3.33
BA-4386/PRC-25	Primary Magnesium	7.5		Not available	to test

## **Rechargeable Batteries**

The Amp Hour capacity of rechargeable batteries as of 2003 is still lower than Alkaline cells, but is getting close. You can get Ni-MH "D" cells with an advertised rating of 9 Amp Hours, but I have not yet tested them. In the future I expect the capacity to be even higher.

## **Charging**

There are a number of ways to charge rechargeable batteries.

In the case of the Rayovac LR20 batteries, I use the Rayovac "3-in-1" charger that holds 4 each "D" cells since this is a special chemistry. This same charger can be used for Ni-MH and Ni-Cad cells. I think there's a temperature sensor in this unit, but have not taken it apart to be sure.

I also use the Maha MH-C777Plus smart charger to charge 10 "D" cells in the 247477BA. It has a temperature sensor that magnetically attaches to a battery and can also discharge Ni-Cad cells which is needed now and then to get rid of the memory effect of Ni-Cads.

A lab type power supply can be used if it has both Constant Voltage as well as Constant Current modes. The Constant Current can be set to the proper value for the battery and a timer used to shut down the power supply after the proper time has passed. For example the Energizer NH50 "D" Ni-MH cell, rated for 2.2 Amp Hours, has a specified charging current of 440 mA. If there was no internal resistance you could charge for 5 hours and the battery would be full. But it may take 50% longer because of losses.

Be sensitive to the fact that if there is a weak cell, it may overheat, catch fire or explode. This is why commercial battery chargers have temperature sensors, timers and/or some kind of intelligent controller.

## **Caution**

All 10 batteries should be of the same model number and date code. If you mix batteries it is possible for a weak cell to over heat and get extremely hot or even explode. This can happen under load or when being charged.

**PRC68.COM**