LOW TEMPERATURE APPLICATIONS

Just as all types of batteries experience a slight increase in capacity as their temperature is increased, they also experience a loss of capacity as their temperature is decreased below 77˚F.

The more rapidly the battery is being discharged, the greater the percentage rated capacity will be lost. In other words, a battery will have to be oversized more to carry a short, fast discharge than a long, slow discharge at the same temperature.

Table 20-1 lists percent of rated current available for various discharge rates at various temperatures. Discharge data for lead acid batteries is usually not published for time periods under one minute. Therefore, no data is available for these short periods. However, in actual fact, because of the severe voltage dip experienced in a lead acid electrochemical couple when it is shock loaded, only about 3% to 5% more current is available at the 10-second rate than the one-minute rate to the same and voltage at standard temperature. It is suggested that the one-minute current data and the appropriate de-rating factor for lead acid cells be used.

PERCENT OF RATED CURRENT AVAILABLE

TEMPERATURE	NICKEL CADMIUM			LEAD ACID	
°F	1sec	1 min	8 hr	1 min	8 hr
77	100	100	100	100	100
70	90	95	99	95	97
60	85	90	95	89	91
50	79	85	89	82	85
40	72	78	84	75	78
30	67	74	80	66	71
20	60	68	75	58	64
10	54	63	70	51	56
0	47	57	65	42	45
-10	43	52	61	34	35
-20	37	47	56	25	25

Table 20-1

Attention must also be given to the actual load, because in addition to a loss of available current from the battery, the current draw of the load may increase. A ready example is the increase in current required to power the starter motor for cranking an engine, if the engine temperature is allowed to fall. It is usually less expensive to maintain the battery temperature up to at least 65˚F to 75˚F, as opposed to increasing the battery size. Engine water jacket heaters are usually used to maintain the engine temperature.

Various types of battery warmers are commercially available. Also, the battery can simply be enclosed, thus containing the batteries own heat for an extended period of time. The formula for calculating heat loss is:

$$\text{Watts} = \frac{(\text{Coefficient of Heat Transfer})}{(3.412)} \frac{(\text{Surface Area})\ (\text{Temp. Diff. in }^{\circ}\text{F})}{(\text{Thickness of Material in Inch})}$$

Note 1: The coefficient of heat transfer for hard wood is 0.6.

Note 2: If the battery is enclosed to contain its own heat, a means must be allowed for the hydrogen gas to escape.

It is fair to mention here that because the specific gravity of the nickel cadmium cell remains virtually constant with charge, the cell will not freeze even if the battery were to become totally discharged.

At the standard specific gravity of alkaline electrolyte (1.190), the cell is safe down to -25˚F. With 1.225 gravity alkaline, it is safe down to -54˚F.

Note: All plastic jars become more brittle at these extreme temperatures.

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