SCREENING AND SELECTION OF NICKEL AND CADMIUM CELL PLATES TO IMPROVE UNIFORMITY

Gerald Halpert

The nickel-cadmium battery has long been the backbone of the satellite's power supply. The cells which make up the battery, however, have suffered for a long time from operational problems and lack of uniformity. These problems can be tied to the materials within the cell–plates, separator, electrolyte, etc.– which until recently have been neglected. A study of the plate materials was initiated in which the purpose was to determine which factors affect operation–which could be predicted prior to cell assembly, and which could be determined nondestructively.

From the early measurements and statistical analyses, it became obvious that there was a strong plate-weight to plate-capacity relationship. This was not altogether expected because the complex manufacturing process involves many variables and the active material constitutes only a portion of the weight. However, if processing is controlled, the plate capacity, which is a function of quantity of active material, will also be a function of the plate weight.

Plate weight distribution was determined for plates from a number of manufacturers. The negative plate weight distribution is given in Figure 1. As can be seen, some manufacturers have controlled processing, e.g., Type T-A; others are not as well controlled, e.g., Type E-N. The distribution shown in Figure 1 is similar to the positive plate weight distribution. In order to determine the weight/capacity relationship for a given batch of plates, ten plates were selected at random, physically and chemically characterized, and subjected to electrochemical capacity test. As an example, characteristics of negative plates from OAO Battery 32-33 are given in Figure 2, in which weight versus capacity is plotted. The correlation coefficient is 0.97, which is close to a perfect 1.0, indicating a very close relationship. The low weight plate is not as unusual as it may seem, in that 5 percent of the plates from the group exhibited a low weight. The standard deviation in capacity can be significantly reduced from 0.22 to 0.06 by removal of this plate. From these data, a regression equation can be determined which allows one to calculate the capacity of a plate without testing, by knowing the weight alone.

The technique was used in the OAO Battery 34-35 cell construction in which a ±3½ percent weight tolerance limitation was utilized. In Figure 3, a comparison is made between Battery 32-33, in which there was no plate screening, and Battery 34-35. The variation in the 20-A-hr nominal cell capacities is 2.8-A-hr for Battery 32-33 and 1.5 A-hr for Battery 34-35.

In conclusion, the method of weight screening of plates is practical, has the advantage of predicting capacity nondestructively before assembly, utilizes 100 percent sampling, and, hopefully, will result in cost savings. The procedure has been used in the building of batteries for OAO, Viking, the NASA space station, and other satellites, and is an integral part of the interim model specification for high reliability nickel-cadmium cells.

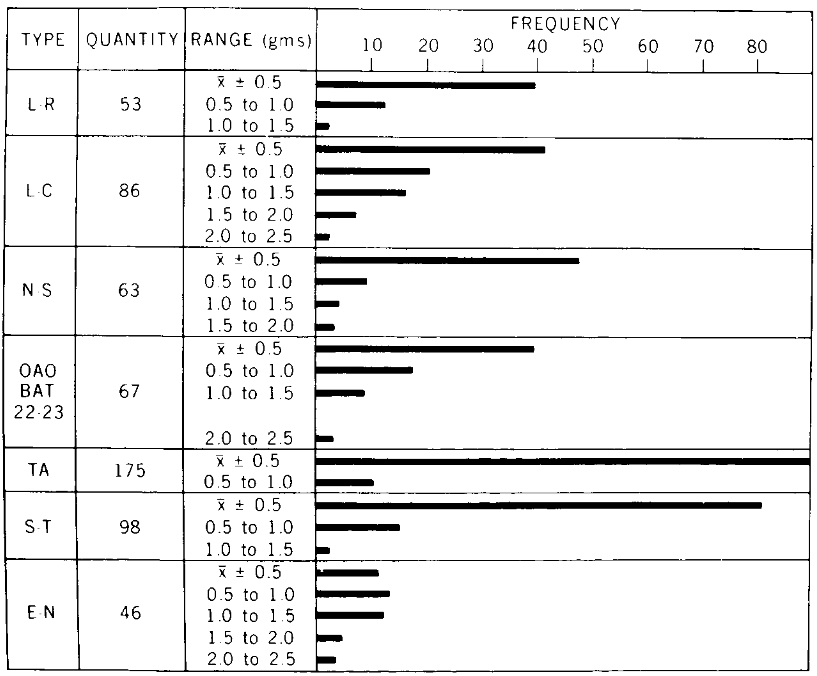

Figure 1—Negative plate weight distribution.

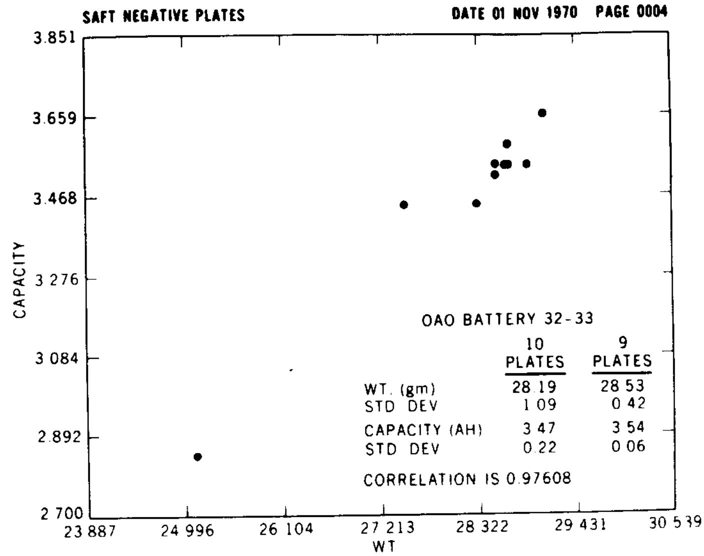

Figure 2–OAO Battery 32-33 characteristics.

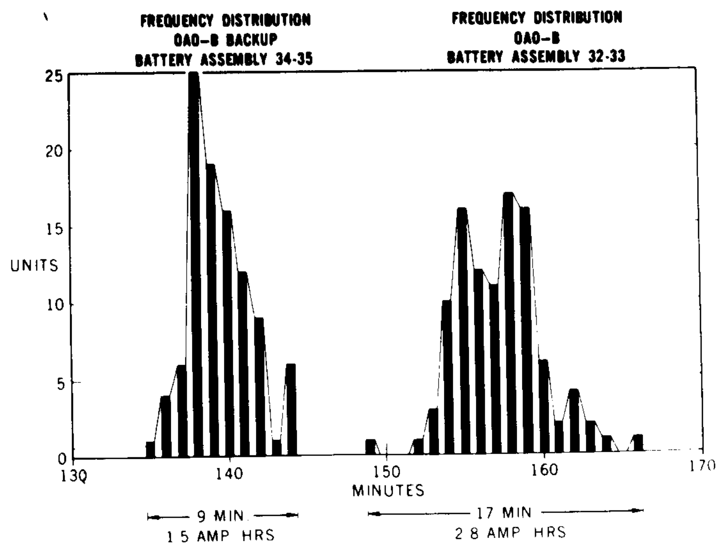

Figure 3–OAO cell selection cycle (discharge rate C/2 = 10 A).