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SETTING UP A NICKEL CADMIUM BATTERY SHOP

The following summary is intended to help in planning a battery shop for servicing main ship aircraft batteries. Local requirements and the type of aviation department may dictate variations in requirements. Although setting up a battery shop involves some expense, a properly outfitted shop is a minor expense compared to the capital costs of the batteries and more importantly, the cost and safety of the aircraft whose proper operation depends upon the effective maintenance of its batteries. The following paragraphs address the most significant items, some in greater detail than others. Should supplemental information be beneficial, contact the Marathon Power Technologies Company distributor in your area. For information on processing equipment for sealed batteries see the above websites.

OVERVIEW

An effective ni-cad battery shop should be:

(a) Clean.
(b) Well Lighted.
(c) Well Ventilated.
(d) Outfitted with the necessary equipment.
(e) Supplied with adequate source of electricity, water and compressed air, as well as sufficient drains.
(f) Provided with the appropriate maintenance manuals.
(g) Conveniently located.
(h) Meet all safety, health and occupancy regulations
(i) Most importantly, staffed with trained and knowledgeable personnel.

THE SHOP

A. SIZE:

A 10'Wx10'Dx10'H shop should be the minimum size to contain all of the recommended equipment listed below. Battery processing time varies in accordance with servicing instructions provided by the battery manufacturer. Additional time may be required if batteries exhibit certain problems such as cellophane breakdown (See the appropriate section of the Christie Operating Manual and / or the battery manual for details). In general, there should be one operator for every 3 to 5 RF80-K Charger/Analyzers.

B. TEMPERATURE:

Battery servicing is best accomplished at temperatures most comfortable for humans (e.g., 25º C). Air conditioning has proven to be beneficial, since it can speed up servicing and produce better batteries. Cooler batteries absorb more electrical energy during charging than do warmer ones, and thus can return more energy when required aboard the aircraft. If air conditioning is not feasible, a cooling fan can be used to remove some heat from the battery. A few suggestions for optimizing the use of the fan:

(j) Position the fan so that the cooling airflow passes down onto the cell-links, as well as the battery case.
(k) Place the battery on small wood blocks (typically 2"x2"x2") to permit airflow under the battery case.
(l) Direct the airflow across the battery **away from** the charger/analyzer.

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C. LIGHTING:
Should be well distributed. Emergency battery powered lights may need to be provided in case of a power failure. Check local regulations for lighting and emergency lighting requirements.

D. WALL/CEILING COLOR:
A light color is best for improved visibility.

E. FLOOR:
Should be washable and provided with adequate drain(s).

F. SECURITY:
The door should be kept closed (for cleanliness) and be lockable (because of the high value of batteries and tools). A window in the door is beneficial. The door should open out, not in.

G. ELECTRICAL SUPPLY:
The alternating current main supply should be adequate to satisfy all charger/analyzers operating simultaneously, plus a safety factor. The RF80-K requires a maximum current input of 23 amps at 230 volts (single phase). The AC main supply should not be shared with other (non-charger) equipment.

H. COMPRESSED AIR:
An adequate oil filter should be readily available for frequent servicing. The filter is relied upon to prevent compressor oil from passing into the cells (e.g. compressed air is used to test the vent caps of some battery manufacturers. Oil on the vent caps could contaminate the cell interior and cause foaming of the electrolyte).

I. TELEPHONE:
Helpful, for communications and may be required in accordance with some safety regulations.

J. LOCATION:
Primarily because of battery weight, the shop should be on the ground floor. It should be convenient to the flight line or to the storage, shipping or receiving facilities. It should not be near metalworking shops or have ventilation ducts coming from areas where metal is ground or cut, fine metal particles can migrate into the batteries. Ventilation ducts should not be shared with painting, electroplating or other chemical processing operations

K. EQUIPMENT
Quality equipment may have a slightly higher initial cost, but saves money in the long run. The following equipment may be required in order to service the batteries. See the battery manufacturers manuals for further information.

(a) **Charger/Analyzer:** The Christie ReFLEX charger/analyzer Model RF80-K has become the standard of the aviation battery market place. It is described in various levels of technical detail in many technical bulletins. Impartial official government evaluation reports from such organizations as the U.S. Air Force, U.S. Army, U.S. Navy, Royal Australian Air Force, Royal Air Force (UK), German Air Force and others have confirmed the contents of those bulletins. The primary reasons why the RF80-K has become the

standard of those Air Forces, as well as commercial battery shop operators include speed of charging, lower overall cost of charging, improved battery performance, superior resultant charger reliability, ease of operation by typical battery shop personnel, stock availability of service parts, and support by its manufacturer.

(b) **Cell Monitoring Instrument:** The Proease DataFX provides a complete, hard copy battery servicing report. It scans the ni-cad battery's cells during charge and discharge, measuring the voltage of each cell at fixed intervals. The voltage of each cell is presented on the display. If a fault condition occurs during the process, a warning light and audible "beep" alerts you to the problem. The display indicates the type of fault and cell(s) involved. When used with an Epson compatible serial printer, it provides a report of the battery process data: cell voltages at various times, current level, battery voltage and error messages. The DataFX simplifies the recording of required data.

(c) **Water:** The replaceable component of battery electrolyte is distilled, de-mineralized or de-ionized water, typically available in sealed containers. Water should have a maximum conductivity of 200,000 ohms per cm3. For those of you in Europe, this equates to 5 micro mohs. Tap water should never be used.

(d) **Shorting Clips:** These clips are used during the deep discharging step. Resistor clips are also beneficial. These are both available from your battery distributor.

(e) **Volt-Ohmmeter**: Such meters (analog or digital) are needed in the processing steps described in either the Christie or battery manufacturer's manual.

(f) **Torque wrench**: Used to confirm that the cell links are tightened in accordance with the battery manufacturer's manual. A range of 0 – 200 inch pounds is preferred. Note 1 inch pound equals 0.112 newton-metres (N.m).

(g) **Brush**: A nylon brush is handy for brushing residue from the top of the battery. **Never** use a wire brush.

(h) **Vaseline**: This neutral coating material, sometimes called petroleum jelly, is brushed on the clean links before returning the battery to service. This is not required by all battery manufacturers nor for all batteries

(i) **Nozzle:** Made of polystyrene and combined with a 20-50cc syringe, it serves to determine the proper cell liquid level. These are available in kits from your battery distributor.

(j) **Visor / Eye Protector**: Beneficial because each cell contains corrosive potassium hydroxide. Always follow appropriate safety practices.

(k) **Thermometer**: Preferably non-metallic nor containing mercury as a temperature indicator (e.g., a glass thermometer containing a colored alcohol column is preferred). This is used to obtain test data should a cell appear to be overheating. This is not required by all manufacturers nor for all batteries.

(l) **Socket wrenches**: Complete set of appropriate sizes, such as 17mm, 14mm, ½ inch, etc these are not required by all manufacturers.

(m) **Cell Puller**: Beneficial when replacing cells. These are available through your battery distributor.

(n) **Shop Vac**: The 40 gallon size is very helpful, especially when used with the nylon brush while cleaning residue off of the battery link area.

(o) **Allen type socket set**: For use on batteries with socket head cap screws. Use these in conjunction with the torque wrench.

(p) **Nut Driver**: Helpful in starting nuts on terminals. Not to be used to tighten nuts.

(q) **Strainer**: A colander-type device for ease of cleaning links and vent caps.

(r) **Vent Plug Pressure Tester**: Helpful in determining that the plugs vent within the approved pressure range. This is required by some battery manufacturers for some batteries

(s) **Mechanical Timer with Audible Signal**: A helpful device when servicing many batteries simultaneously.

(t) **Tape Recorder**: beneficial when scanning cells during charge or discharge. Eases the collection of data when there is only 1 person in the shop.

(u) **Full-Body Safety Shower as well as Separate Eye Flusher**: Should be conveniently located in accordance with safety regulations.

(v) **Fire Extinguishers**; conveniently located as per local standards, approved type, frequently inspected. Local regulations will dictate the exact requirements.

(w) **Non-Metallic Work Surfaces**: Capable of safely holding the intended weights.

(x) **Vent Hoods**: Preferred by some operators, especially in small tightly closed shops. The battery is placed under the hood, which provides effective air removal for venting the gases generated during battery charging. When multiple batteries are being serviced within the same room make-up air may be required. If there is a potential for the hydrogen evolved in charging to reach the lower explosive limit of 4% forced ventilation **must** be provided. As an aid in determining the ventilation required please consider the following:

1) .17166 liters per minute of explosive atmosphere is evolved per cell per each amphour of overcharge.
2) I cubic foot equals 28.32 liters
3) No safety factor has been included
4) Always ventilate for the anticipated worst case.

Example… 4 each 20 cell batteries overcharging at 9.2 amps.
.17166 lpm X 9.2 ah overcharge X 80 cells = 126.34 lpm of explosive atmosphere evolved.
126.34 divided by 28.32 = 4.46 cfm ventilation required without a safety factor.

(y) **For Lead-Acid Batteries**: Although certain of the above items can also be used in a lead-acid shop, the items specifically required for a lead-acid shop include a hydrometer, sulfuric acid, baking soda, and a complete outfit of rubber protective clothing (apron gloves, and pants). Lead-Acid batteries and nickel cadmium batteries must never be charged and discharged within the same enclosed area.

(z) FAA Regulations: Each person performing maintenance on aircraft batteries " shall use the methods, techniques, and practices prescribed in the current manufacturer's maintenance manual". Please see 14 CFR part 43.13 for further information.

L. Record Keeping

Associated with good maintenance practices is the keeping of accurate records. These records Serve as a verification of the maintenance procedure and provide information for establishing optimum service schedules. When a Data FX is not available a manually recorded battery data sheet must be used. Sample battery data sheets are included in many Marathon manuals.

M. Training

Battery service life and costs depend upon the quality of service the batteries receive. Only a trained technician can properly service today's batteries. Battery manufacturers provide classes in the servicing of their products. Contact the manufacturer of your batteries for training information.