CADEX® C7400 Battery Analyzer

General

The purpose of this product search was to identify and test instrumentation that would prolong the service life of rechargeable batteries in government owned equipment thereby reducing ownership cost and consequently reducing the environmental impact of battery waste generated. The instrument tested was a Cadex C7400 provided on a loaner basis by Sigma Marketing Co. Inc., a Cadex representative in the EPA Region I area. The loaner unit was tested on a variety of batteries over a 6 month period. Basic information of the unit tested is:

Cadex C7400 *80 Watts*

- Battery voltage range 1.2 to 15V
- Charge/discharge current up to 4A per station
- Maximum charge power 55 watts per station
- Maximum discharge power 35 watts
- List price $2,100

The Cadex Analyzer proved to be an efficient and effective tool for servicing and reconditioning batteries for critical field instrumentation and communication devices. A wide array of test and reporting methods provided detailed, accurate and defensible data as to the capabilities of the batteries analyzed. Most types of battery chemistries and configurations are able to be analyzed, and many manufacturers' existing products have pre-programmed matrices and performance statistics in the database.

Some of the features of this system include, but are not limited to, the following:

Custom Reporting

The analyzer along with the BatteryShop™ software allows the user to input specifics relating not only to the battery, but to the unit in which it is used, the owner information, serial number and part number. This feature aids in keeping defensible records organized and accurate. A service label can also be printed and attached to the battery providing visual confirmation to the end user of the battery's reliability.

Custom Programming

As there are wide arrays of battery types and configurations, individual battery statistics and optimal service techniques can be programmed into the analyzer for more effective servicing. Combinations of existing service programs can be linked together to almost fully automate a battery's recovery or preparation. Special or custom battery types can also be accounted for with this programming freedom. Even as new battery types are developed, the analyzer can be adapted to continually service evolving battery products.

Capacity Determination

The analyzer runs charge and discharge cycles to determine the battery's capacity and output per their manufactured specifications. This determines the overall health of the battery and reports a percentage of the designed capacity.

Reconditioning

Should a battery not meet the designed standard for capacity or performance, the analyzer will exercise the battery in an attempt to restore the full capability of the battery. This is typically performed when battery deterioration or memory has resulted from less than ideal usage and charging conditions.

Reconditioning can effectively extend the life of the battery well beyond the expected life span and/or warranty period.

Run-Time Determination

The run-time or 'Duty-Cycle' of a battery can be determined through discharge cycles that can be performed by the analyzer. Pre-programmed and custom designed simulations of work that a battery's instrument performs, can determine the expectations of the instrument in real life conditions. This ensures, during planning or at the time of deployment, a high degree of confidence in mission critical instrumentation and the batteries involved.

Preconditioning

New batteries are often not manufactured to perform at their maximum capability until a number of charge and discharge cycles have been experienced. The individual cells of a battery require some degree of operation before their charges can equilibrate. The analyzer, using its Prime program, effectively exercises the battery to reach its full potential prior to installation. This ensures the optimal performance once in use and allows for the greatest potential life span.

Case study using rechargeable batteries for Motorola 2 way radios:

Currently, EPA Region 1 maintains a 2-way, hand held radio capability made up by two Motorola Models: HT1250 and XTS 5000. The current maintenance policy for these types of batteries is to replace them at the end of the manufacture's warranty period. Because it is the manufacture's position that the batteries are expected to have 80% capacity at the end of the warranty period, they are replaced at this interval to insure agency readiness. For many other rechargeable batteries used by the EPA, Eagle Instruments adheres to a schedule of regular charging, cycling and run down testing. For brevity sake we will move away from the instrument model and focus on their respective battery types. These batteries were analyzed and reconditioned using the Cadex 7400.

For details of the results, please refer to Tables 1 thru 4. The results are summarized below:

HT1250

For this radio type, two battery chemistries are present – Nickel Cadmium (NiCd) and Nickel Metal Hydride (NiMH). In general, Motorola will provide a warranty for these batteries that will last 12 to 18 months. This warranty assures that the battery will maintain 80% of its specified capacity under conditions of normal use and care.

Eagle Instruments tested 64 batteries associated to the HT1250, of these 54 were reconditioned. These batteries are believed to have come into EPA service in 2003. If this is the case, results indicate that the batteries on hand have lasted long past the period of warranty provided upon purchase.

Battery Model	Number of Batteries Tested	Number of Batteries w/ <80% Capacity	Avg. Increase in Capacity (%)
HNN9011 (NiCd)*	54	2	11
HNN9010 (NiMH)	10	-	-

*Batteries reconditioned by CADEX unit.

XTS5000

For this radio type, two battery chemistries are present – Nickel Cadmium (NiCd) and Nickel Metal Hydride (NiMH). In general, Motorola will provide a warranty for these batteries that will last 12 to 18 months. This warranty assures that the battery will maintain 80% of its specified capacity under conditions of normal use and care.

Eagle Instruments tested 34 batteries associated to the XTS5000, of these 20 were reconditioned. These batteries are believed to have come into EPA service in 2003. If this is the case, results indicate that the batteries on hand have lasted long past the period of warranty provided upon purchase.

Battery Model	Number of Batteries Tested	Number of Batteries w/ <80% Capacity	Avg. Increase in Capacity (%)
NTN8297A* (NiCd)	20	0	22.6
NNTN4437B** (NiMH)	14	1	-

*Batteries reconditioned by CADEX unit.

**This model battery is considered a “smart battery” and works in tandem with the Motorola Impres System. Impres is a proprietary system that utilizes a specially designed charger/battery match that allows the charger to maintain battery charge, but also reconditions them as needed. This system prolongs battery service life.

Cost Savings Analysis
Replacement of the batteries tested would potentially cost Region I the value determined, every 12 to 18 months.

Radio Model	Number of Batteries Tested	Replacement Cost of Batteries*	Total Replacement Cost
HT1250	64	$80	$5120
XTS5000	34	$120	$4080

***Based on BPA pricing received

That would total $9200 every 12 to 18 months using the pricing available and a policy of replacement based on warranty expiration.

For sake of illustration, if the batteries that we have discussed were purchased originally in June of 2003, they could have been replaced, using the longest warranty period, every 18 months. If this hypothetical had been realized, replacement of Motorola radio batteries would have occurred twice so far at a cost of $18,400 with an additional replacement due at the beginning of 2008 for an additional $9,200. Thus by the spring of 2008, the Region would have had an outlay of $27,600 for the replacement of Motorola batteries alone.

Summary
The Cadex Analyzer allows the technician to fully understand the capabilities of the batteries that the user depends on in the field. Coupled with the potentially large cost saving associated with battery replacement, an effective battery management program provides financial savings and operational readiness.

Furthermore, although it is difficult to tabulate, it is more than reasonable to project that the Region can significantly curb its contribution to the environmental impact associated to decreased disposal of its rechargeable battery inventory.

Benefits:

1. Provides end user with quantifiable information about the condition of the battery when deployed.
2. Prolongs life of battery through conditioning and by providing exact capacity of battery. Allows maintenance facilities to operate on a change out schedule based on actual capacity and not by time intervals.
3. Saves the government money in battery replacement without sacrificing readiness or equipment reliability
4. Reduces the government's environmental impact by reducing the amount of hazardous waste that is generated.

Recommended Configuration

1. Cadex 7400 C Series Battery Analyzer – 80 watt P/N: 07-740-0100
2. Cadex BatteryShop™ 1 Software P/N: 07-770-2001
3. Flex Arm Adapter – P/N: 07-110-0180
4. Universal Alligator Clips Adapter – P/N: 07-110-0115

5. DYMO SE300 Label Printer – P/N: 00-004-3013
6. DYMO Battery Labels 1500/roll – P/N: 00-004-3031

Total list cost of recommended configuration is $3,065.

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Product Study of Cadex C7400 Battery Analyzer by Eagle Instruments

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By: Isidor Buchmann
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The purpose of the Product Study was to identify instrumentation that will prolong the life of rechargeable batteries in government-owned equipment to reduce operational costs and decrease environmental concerns. The study was done on a Cadex C7400 by testing a variety of batteries over 6 months. The Cadex analyzer proved to be an effective tool to service batteries for critical field instrumentation and communication devices.

EPA Maintenance Policy

The EPA maintenance policy mandates to replace a battery after the 12 or 18-month warranty period. This assures that all batteries operate at a capacity bandwidth of 80–100%. The test revealed that almost all batteries had a higher capacities than 80% at the warrant expiry date, indicating that a wholesale replacement is not necessary.

Cost Savings Analysis

The test involved 64 batteries for the Radio Model *Motorola HT1250* and 34 for the *XTS5000.* The cost of the HT1250 battery was $80 ($5,120 for 64); the cost of the XTS5000 battery was $120 ($4,080 for 34). An end-of-warranty replacement would result in a cost of $9,200 every 12–18 months. With periodic analysis, however, most batteries can be used for 3–5 years without fear of unexpected down-time. This results in cost savings of $18,400 and more in the EPA study performed.

Advantage of Battery Maintenance

With a battery analyzer, batteries are only replaced when the capacity drops below 80% (or other chosen capacity thresholds), enabling a full utilization of each battery. In the EPA study, 3 out of the 98 batteries tested dropped below 80%. These packs would be identified with a periodic analysis using a battery analyzer.