Proposal Information Template for:
Battery Charger Systems

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California Energy Commission
In consideration for the 2008 Rulemaking Proceeding on Appliance Efficiency Regulations,
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Proposal Information – Battery Charger Systems

2008 Appliance Efficiency Standards

CONTENTS

Purpose

This document is a report to be used by researchers who are evaluating proposed changes to the California Energy Commission's (Commission) appliance efficiency regulations (Title 20, Cal. Code Regs, §§ 1601 – 1608). This report specifically covers battery charging systems (BCS).

Background

The function of many consumer electronic products depends on portable power to remain operative when disconnected from the AC wall outlet. Many portable products utilize rechargeable battery systems to supply portable power rather than rely on the availability of mains power. Electricity from the AC wall outlet is used to maintain various low power and trickle charge modes and to charge the battery itself. For the purpose of this report, the term "consumer battery charger" includes devices that are designed to run on battery power during part or all of their duty cycle. Battery chargers coupled with their batteries are together referred to as battery charger systems. This term covers all rechargeable batteries or devices incorporating a rechargeable battery, and the chargers used with them. The battery charging electrical contacts and charging circuitry may or may not be located within the housing of the appliance itself. Some products that are included in this definition (for example: cordless power tools) charge the battery with a dedicated charger and power supply combination that is separate from the appliance. For other products, like cellular telephones, the charging circuitry is typically located within the housing of the product, with an external power supply to connect the charging circuitry to the AC outlet. This report includes both of these types of appliances, as well as those units that are sold solely for the purpose of charging rechargeable batteries. This includes batteries of a custom form factor as well as the familiar form factors: AAA, AA, C, D, and 9V. Not included in the definition of consumer battery charger are battery analyzers that are intended for scientific and diagnostic testing.

Battery charger systems cover a broad range of consumer products and use several different charging technologies and battery chemistries. Because of the broad scope of products, there is significant energy savings potential in California.

Substantial interactions exist between the proposed battery charger standard and a related one for external power supplies. Some of the savings achievable with present battery chargers stem from improvements in their power supply efficiency.

Overview

Recommendation to Adopt Test Procedure	Pacific Gas and Electric Company (PG&E) and its consultant Ecos recommend that the CEC adopt the Energy Efficient Battery Charger System Test Procedure developed by Ecos on behalf of PG&E.
Recommendation to Call for Data	Pacific Gas and Electric Company (PG&E) and its consultant Ecos recommend that the CEC issue a call for test data from manufacturers or other interested parties (see Appendices herein for proposed draft call for data). Data received by May 16, 2008 can be used to help determine any necessary modifications to the following proposed standards.
Description of Standards Proposal	The proposed standard will have three components: Active, Standby, and Maintenance. Active mode considers battery energy: $$eff = \frac{E_{batt}}{E_{24}} \geq \frac{E_{batt}}{a + b * E_{batt}}$$ The standard could also be considered as an energy budget: $$E_{24} \leq a + b * E_{batt}$$ A two tier, staged standards approach, addresses first a near term standard to identify and regulate the least efficient products, and second, an eventual standard for improved efficiency. The tentative schedule for Tier A requires an effective date of January 2010 and for Tier B, January 2011. The two-tier approach will allow time for manufacturers to change their design to meet the increasingly stringent standards. For specific information, see the Recommendations Section.
California Stock and Sales	The stock of battery charging products in California is currently estimated at 130 million units. The product categories with the largest stock numbers are home electronics, cell phones, cordless phones, and information appliances. The compound annual growth rate (CAGR) for sales varies significantly from one product to another, with some products growing at rates of over 100%. A small number of product categories are currently experiencing negative growth, due to competition with other more popular battery-powered products. For example, the sales CAGR for cordless phones is negative 9%, while for cell phones it is close to 17%. Similarly, portable CD players are at negative 20%, while mp3 players have a 79% CAGR. While categorical CAGRs could be calculated, an overall CAGR for BCSs would be inaccurate due to the large range of products.

Energy Savings and Demand Reduction	Energy delivered from single-phase BCS in California is estimated to be 1,000 GWh/year, while the actual energy used to charge these products is 4,000 GWh/year. Full compliance with the external power supply Tier 2 standards would reduce this to 3,800 GWh/yr. The two tiers of proposed battery charger standards could save an additional 36% to 56% of the 3,800 GWh/year. Tier A, with a savings of 36% could save California 1,350 GWh/year, while Tier B, with a savings of 56%, could save 2,120 GWh/year. The demand reduction ranges from 167 to 260 MW.
Economic Analysis	The incremental cost of improved charging technology is typically minimal to none. In many cases, inefficient products utilize similar charging components similar to highly efficient products, while achieving a drastically lower efficiency. Due to the reduced incremental cost or lack thereof, there should be a positive net-benefit to the consumer. Further cost benefit analysis will be conducted.
Non-Energy Benefits	Because many NiCd and NiMH batteries are overcharged, they are discarded long before their potential lifetime. A BCS standard would require smarter charging technologies, resulting in reduced battery overcharging, and therefore extending the life of certain batteries. For the consumer, the standard could result in fewer trips to the toxic collection center, fewer trips to the store for batteries, and decreased battery replacement cost. Consumers could also benefit from a reduction in toxic landfilled batteries, Currently, NiCd batteries present the most toxic health threat, even though they make up a large percentage of the rechargeable battery market. The EU banned cadmium for use in battery products in 2006, with some exemptions. China has also passed legislation banning cadmium in some products. The U.S. has no federal legislation restricting cadmium in battery products, but several states have unsuccessfully tried to ban the sale of it within their boundaries.
Environmental Impacts	This standard, if enacted, should not cause any adverse environmental impacts. The standard would result in improved California air quality, a reduction in global warming pollutants, and a similar reduction in other power plant emissions. These savings can be quantified in terms of power plants saved, carbon emissions avoided, and fewer cars on the road. With a 36% reduction in BCS energy, California could save 1,350 GWh/year, saving close to 1/2 a power plant, 715 million lbs of CO_2, and removing 64,600 cars from the road. With a 56% reduction in BCS energy, California could save 2,120 GWh/year, saving close to 2/3 power plant, 1.1 billion lbs of $CO_{2,}$ and removing 101,400 cars from the road.

Acceptance Issues	Consumer acceptance issues are positive due to a “smart” charger’s product characteristics. More efficient chargers are typically lighter and lead to greater product portability for the consumer.
AB 1109 (California Lighting Efficiency and Toxics Reduction Act)	Not Applicable.
Federal Preemption or other Regulatory or Legislative Considerations	It is unclear currently how the recent passage of EISA 2007, the federal energy legislation, will impact a battery charger standard in CA. This legislation does not specifically address standards for those EPSs that accompany battery-powered products, and we therefore assume that existing CA Title 20 regulations on battery chargers will not face federal preemption. Additionally, EISA 2007 outlined a timetable for the U.S. DOE to evaluate and propose federal battery charger standards. A final rule “that prescribes energy conservation standards for battery chargers…” must be issued by July 1, 2011, and any proposed standard would take effect three years later, in 2014. It is likely that the federal government would look to California and other jurisdictions in the interests of harmonization on Test Procedure and standards approaches.

Methodology
To fully develop an accurate BCS standard, the following steps were taken:

1. Developed a BCS Test Procedure including active, maintenance, and no battery mode
2. Tested a broad range of products, in the end totaling more than 250
3. Compiled data to analyze how BCSs utilize energy, how energy relates to battery chemistry and battery capacity, how energy relates to specific products, and how different charging technologies work
4. Conducted market research and developed product categories
5. Evaluated scope of tested products in order to better represent the California market
6. Conducted California energy analysis and developed staged standards based on energy savings
7. Finalized Recommendations for the BCS Test Procedure based on testing experience
8. Finalized recommendations for Standards Specifications

Analysis and Results
There is significant energy savings potential among BCSs. These products consume around 4,000 GWh of energy a year, which could be reduced by 36% initially, and up to 56% through the implementation of staged standards. If all products include a more efficient Level IV EPS, there would be an immediate 5% savings. Beyond this, larger changes in the

charging circuitry are needed, presumably with little incremental cost to manufacturers since the costs of components used in efficient and inefficient chargers do not vary significantly.

Some of the largest energy savings potential exists in the following product categories: cordless phones, universal chargers, information technology, emergency backup battery systems, and cell phones. These consumer products currently consume about 2,800 GWh/yr for charging the batteries, but the batteries deliver only about 300 GWh/yr. This is a net efficiency of less than 11%. The recommended standards would increase the efficiency of these products to 37 to 40%, saving over 2,000 GWh/yr.

One of the most immediate efficiency improvements that can be made to traditional battery charger technologies is to substitute switch mode circuitry for copper-wound transformers. Doing this not only saves materials, but also provides a smaller, lighter products, which saves money on shipping.

Large single-phase chargers used in products such as golf carts, electric vehicles, forklifts, etc. account for about 1,200 GWh/yr. They constitute a very small portion of the overall BCS units in California, about 147,000 units. Improvements to these chargers would result in savings of about 250 GWh/yr, more than 1 MWh/yr per unit.

Although this document addresses only the energy savings from single-phase chargers, Three-phase chargers should also be considered. Preliminary estimates are that there are 64,000 three-phase battery chargers in California, which consume about 2,000 GWh/yr for forklifts alone. A savings opportunity of 300 GWh/yr is possible, in some instances, perhaps as much as or more than 4 MWh/yr per unit. Further research is needed in this area, to determine the extent and reliability of energy savings from three-phase battery chargers.

Recommendations

Pacific Gas and Electric Company (PG&E) and its consultant Ecos recommend that the CEC adopt the Energy Efficient Battery Charger System Test Procedure, version 1.1 developed by Ecos on behalf of PG&E. We also recommend that the CEC issue a call for test data from manufacturers or other interested parties (see Appendices herein for proposed draft call for data). Data received by May 16, 2008 can be used to help determine any modifications to the proposed standards that may be needed. Although the Test Procedure will be added to Section 1604, definitions from the Test Procedure will also need to be added to Section 1602. The definitions section of the Test Procedure is included in the Appendices section of this Template.

Proposed Battery Charger System Efficiency Standards for the CEC:

We recommend that the CEC consider a two-tiered set of efficiency standards, with Tiers A and B to be adopted simultaneously for staged implementation as follows:

- Tier A would be a mandatory standard with enforcement to begin as soon as practical (9 months to 1 year after formal adoption by the CEC). It is intended to remove the least efficient products from the marketplace quickly.

- Tier B would be a mandatory standard with an effectiveness date approximately 12-15 months after the effectiveness date of Tier A. This efficiency level is readily achievable with cost-effective design features and could form the basis of voluntary labeling or utility incentive programs prior to its adoption as a mandatory standard.

The standards will apply to all ac-powered battery chargers included within the scope of the Energy-Efficient Battery Charger System Test Procedure. This includes all battery charger systems with a single-phase ac input power of less than 2 kW, with a few exceptions as detailed in the Test Procedure.

Chargers will be divided into two groups:

- *Consumer Product Chargers* includes all battery chargers not in the Large Universal Charger group.
- *Large Universal Chargers* includes chargers for automotive, marine, RV, golf cart, forklift, and road-worthy electric vehicle batteries. These chargers are designed to work with any brand of battery (of an appropriate chemistry) and over a significant range of amp-hour capacity. They deliver at least 12 volts (nominal) and at least 5 amps of charging current.

Preliminary proposed standards levels for the consumer product chargers are listed below. Standards proposals for large universal chargers are still to be determined. We expect that these chargers in this group will be allowed higher power levels than the smaller chargers in the low power modes, but will also be expected to achieve higher charge mode efficiencies.

Battery chargers that can charge batteries of different capacities or voltages are required to be tested multiple times, as specified in the Test Procedure. These chargers are required to meet the efficiency and power specifications separately for each test. If the charger is tested at both 115 V 60 Hz and 230 V 50 Hz, only the tests performed at 115 V 60 Hz must meet the specifications.

The proposed requirements for consumer product chargers under Tier A are:

A1. The 24-hour charge-and-maintenance energy shall not exceed 36 Wh + 2.5 * Eb, where Eb is the measured battery energy capacity in watt-hours. This is equivalent to having an efficiency of at least:

$$\textit{Efficiency} \geq Eb / (36\ Wh + 2.5 * Eb)$$

A2. The maintenance power shall not exceed 1.5 W.
A3. The no-battery power shall not exceed 1.0 W.
The proposed requirements for Tier B are:

B1. The 24-hour charge-and-maintenance energy shall not exceed 12 Wh + 1.6 * Eb. This is equivalent to

$$Efficiency \geq Eb / (12\ Wh + 1.6 * Eb)$$

B2. The maintenance power shall not exceed 0.5 W.
B3. The no-battery power shall not exceed 0.3 W.
B4. If the peak ac input current exceeds 1 amp in charging, maintenance or no-battery mode, then the power factor in that mode shall either (a) be at least 0.55, or (b) be at least 0.50 at both 115V 60 Hz and 230V 50Hz.
Note: If not reported, the peak current can be calculated as

$$I_{peak} = (InputPower * CurrentCrestFactor) / (InputVoltage * PowerFactor)$$

B5. If the ac rms input current exceeds 1 amp in charging, maintenance, or no-battery mode, then the power factor shall be at least 0.90 in that mode.
Note: The rms input current can be calculated as:

$$I_{rms} = InputPower / (InputVoltage * PowerFactor)$$

Estimated Energy Savings
We estimate that 130 million single-phase battery chargers in the state of California are within the scope of this standard, as of 2007. Base case energy consumption can be calculated one of two ways. The first base case presumes that most battery chargers sold in 2007 with an external power supply did not comply with California's EPS standards or complied only with Tier 1 (phased in between January and July of 2007). This leads to a base case energy consumption estimate of approximately 4,000 GWh/year of electricity. The second base case presumes that all battery chargers sold in 2007 with an EPS that is subject to Tier 2, in fact complied with California's Tier 2 EPS standards (given the prevalence of ENERGY STAR products). This yields additional energy savings of about 5% and a base case value of 3,800 GWh/year. The difference is small because most of the large battery charging systems employ internal power supplies.

California's EPS standards apply only power supplies up to 250 W. Since the proposed battery charger standards will apply to battery chargers that might have EPSs supplying more than 250W, these larger battery charger systems might contain power supplies that are not covered by the Tier 2 EPS standards. PG&E & Ecos recommend that the Commission address this potential discrepancy by noting that the definitions and procedures contained in the battery charger Test Procedure include the electricity used by the external power supply (if any). Thus, even though larger systems might have EPSs not covered by the Tier 2 EPS standard, the overall electricity consumption of the battery charger system, including the external power supply, would still be required to meet any levels set by a standard for battery charger systems.

In the proposed battery charger standard, Tier A products will average slightly lower energy use (about 5 to 6%) than the standards require, due to manufacturers' preference for leaving a margin of error between their design targets and legal requirements to account for manufacturing tolerances. Thus, we estimate that a Tier A standard would reduce energy consumption to 2,450 GWh/year -- a 39% reduction from the higher base case or a 36% reduction from the lower base case.

Similarly, we estimate that a complete stock turnover to Tier B-compliant battery chargers will reduce energy consumption to 1,680 GWh/yr. This represents a 58% reduction from the higher base case or a 56% reduction from the lower base case.

In summary, we would expect these standards to save California about 2,120 GWh/year, above and beyond what can be saved by the EPS standards alone.

Proposed Changes to Title 20 Code Language

The following is proposed language, by section, for the Title 20 Appliance Efficiency Regulations:

Section 1601. Scope.

(y) (1) Battery Chargers coupled with their batteries, which together are referred to as ***battery charger systems*.** This term covers all rechargeable batteries or devices incorporating a rechargeable battery and the chargers used with them. Battery charger systems include, but are not limited to:

- electronic devices with a battery that are normally charged from ac line voltage or dc input voltage through an internal or external power supply and a dedicated battery charger;
- the battery and battery charger components of devices that are designed to run on battery power during part or all of their duty cycle (such as many portable appliances and commercial material handling equipment);
- dedicated battery systems primarily designed for electrical or emergency backup (such as emergency egress lighting and uninterruptible power supply (UPS)
- systems);
- devices whose primary function is to charge batteries, along with the batteries they are designed to charge. These units include chargers for power tool batteries and chargers for automotive, AA, AAA, C, D, or 9 V rechargeable batteries.

(2) **Limitations:** With regard to battery charger systems, the scope is limited to those battery charger systems that operate on single-phase ac input power or dc input power and that have a nameplate input power rating of 2 kW or less. The scope is also limited to battery charger systems whose battery has a rated energy capacity of 50 kWh or less. Battery chargers capable of charging batteries both less than and greater than 50 kWh shall be tested only with suitable batteries of 50 kWh or less.

Laboratory testing equipment used to test and analyze batteries is specifically excluded from the scope of this test procedure. However, battery charger systems that provide power for portable laboratory testing equipment are included.

The scope includes a battery charger that is packaged or sold without batteries.

Some examples of battery charger systems included in this scope are: cellular and cordless telephones, cordless power tools, laptop computers, cordless shavers, uninterruptible power supplies emergency egress lighting, golf carts, some forklifts, portable lawn tools, and rechargeable toys.

Note: The charger circuitry of battery charger systems may or may not be located within the housing of the end-use device itself. In many cases, the battery may be charged with a dedicated external charger and power supply combination that is separate from the device that runs on power from the battery.

Section 1602. Definitions.

(y) Battery Charger Systems

1. **Active Power (P)** is the average value, taken over one or more cycles, of the instantaneous power (which is the product of instantaneous voltage and current).

2. **Ambient Temperature** is the temperature of the ambient air surrounding the UUT.

3. **"Apparent Power (S)"** means the apparent power (S) is the product of root-mean-square (rms) voltage and rms current (VA).

4. **"Batch Charger"** means a battery charger that charges two or more identical batteries simultaneously in a series, parallel, series-parallel, or parallel-series configuration. A batch charger does not have separate voltage or current regulation nor does it have any separate indicators for each battery in the batch. When testing a batch charger, the term "battery" is understood to mean, collectively, all the batteries in the batch that are charged together. A charger can be both a batch charger and a multi-port charger or multi-voltage charger.

5. **"Battery Chemistry"** means the chemistry of the rechargeable battery, such as nickel cadmium, nickel metal hydride, lithium ion, lithium polymer, rechargeable alkaline, or lead acid.

   Note: The chemistry of the battery is typically printed on the label of the battery itself, can be found in the manufacturer's instructions, or can be obtained from the manufacturer of the battery system.

6. **"Battery Conditioning "**means a special procedure performed on a battery to ensure optimal performance.

7. **"Battery Discharge Energy"** means the energy, in watt-hours (Wh) delivered by the battery as measured by this test procedure.

   Note: This is the *measured* battery discharge energy as distinct from the *Rated Battery Energy* defined below.

8. **"Battery Maintenance Mode"** means the state in which the battery charger system is connected to input power, and the battery charger may be delivering current to the battery in order to counteract or compensate for self-discharge of the battery.

Note: In this state, the battery is at or near 100% capacity.

9. **"Battery Rest Period"** means a period of time, between discharge and charge or between charge and discharge, during which the battery is resting in an open-circuit state in ambient air.

10. **"Charge Mode"** means the state in which the battery charger system is connected to input power, and the battery charger is delivering current in order to bring the battery from a state of discharge to a state at or near 100% capacity.

Note: a battery charger system may have more than one charge mode.

11. **"C-Rate"** means the rate of charge or discharge, expressed in terms of the rated charge capacity of the battery. A discharge rate of one-C draws a current (in amperes or milliamperes) equal to the rated charge capacity (in ampere-hours or milliampere-hours) and would theoretically discharge the battery in one hour. Other currents are expressed as multiples of one-C, so 0.2C is one fifth of that current.

12. **"Crest Factor"** means for an ac or dc voltage or current waveform, the ratio of the peak instantaneous value to the root-mean-square (rms) value.

    Note: Crest factor is expressed as a ratio, for example a pure sine wave has a crest factor of 1.414.

13. **"End-of-Discharge Voltage"** means the specified closed-circuit battery voltage at which discharge of a battery is terminated.

14. **External Power Supply (EPS)** means external power supplies that are designed to convert ac line voltage into low voltage output (either ac or dc) and are contained in a separate housing from the product they are powering.

    Note: Regulation of external power supplies will be pre-empted by federal legislation in the Energy Independence and Security Act of 2007, effective July, 2008.

15. **"Instructions" (or "manufacturer's instructions")** means the documentation packaged with the product in printed or electronic form and any information about the product listed on a website maintained by the manufacturer and accessible by the general public. "Instructions" includes any information on the packaging or on the product itself. "Instructions" also includes any service manuals or data sheets that the manufacturer offers for sale to independent service technicians, whether printed or in electronic form.

16. **"Multi-port Charger"** means a battery charger which charges two or more batteries (which may be identical or different) simultaneously. The batteries are not connected in series or in parallel. Rather, each port has separate voltage and/or current regulation. If the charger has status indicators, each port has its own indicator(s). A charger can be both a batch charger and a multi-port charger if it is capable of charging two or more batches of batteries simultaneously and each batch has separate regulation and/or indicator(s).

17. **"Multi-voltage Charger"** means a battery charger that, by design, can charge a variety of batteries (or batches of batteries if also a batch charger) that are of different rated battery voltages. A multi-voltage charger can also be a multi-port charger if it can charge two or more batteries simultaneously with independent voltage and/or current regulation.

18. **"No-Battery Mode"** means the state in which the battery charger system is connected to input power, is configured to charge a battery, but there is no battery connected to the charger output.

    Note: In this mode the system would begin charging a battery if one were connected.

19. **"Off Mode"** means the state in which the battery charger is switched "off" using a switch located on the charger, if such a switch is included, while the charger is connected to the input power source and used in accordance with the manufacturer's instructions.

    Note: If the charger does not have an on/off switch, off mode is the same as no-battery mode. If the charger does have an on/off switch, the charger will not begin charging a battery if one is connected while the charger is switched off.

    Further note: Products operating in Off Mode may still have some residual power consumption, which is the purpose of measuring power consumption in the Off Mode.

20. **"Power Factor** "means the ratio of the active power (P) consumed in watts to the apparent power (S), drawn in volt-amperes (VA).

$$PF = \frac{P}{S}$$

    Note: This definition of power factor includes the effect of both harmonic distortion and phase angle displacement between the current and voltage.

21. **"Rated Energy Capacity"** means the product (in Wh) of the Rated Battery Voltage and the Rated Charge Capacity.

    Note: This is distinct from the *measured* Battery Discharge Energy defined above.

22. **"Rated Battery Voltage"** means the battery voltage specified by the manufacturer and typically printed on the label of the battery itself. If a batch of batteries includes

series connections, the Rated Battery Voltage of the batch is the total voltage of the series configuration, that is, the rated voltage of each battery times the number of batteries connected in series. Connecting multiple batteries in parallel does not affect the Rated Battery Voltage.

Note: if not printed on the battery, the rated battery voltage can be derived from the electrical configuration and chemistry of the battery.

23. **"Rated Charge Capacity"** means the capacity, usually given in ampere-hours (Ah) or milliampere-hours (mAh), specified by the manufacturer and typically printed on the label of the battery itself. If a batch of batteries includes parallel connections, the rated charge capacity of the batch is the total charge capacity of the parallel configuration, that is, the rated charge capacity of each battery time the number of batteries connected in parallel. Connecting multiple batteries in series does not affect the rated charge capacity.

    Note: it is the quantity of electric charge the manufacturer declares the battery can store under particular pre-specified test conditions.

24. **"Rated Input Frequency"** means the range of ac input frequencies designed to operate the unit under test (UUT); assigned by the manufacturer and usually printed on the housing of the charging device. If the UUT includes an external power supply (EPS), this is the frequency of the input to the EPS, not the frequency of the input to the other component(s) of the UUT.

25. **"Rated Input Voltage"** means the range of ac or dc input voltage designed to operate the unit under test (UUT); assigned by the manufacturer and usually printed on the housing of the charging device. If the UUT includes an external power supply (EPS), this is the voltage of the input to the EPS, not the voltage of the input to the other component(s) of the UUT (from the EPS).

26. **"Total Harmonic Distortion (THD)"** means a measure of the degree to which a waveform departs from a pure sinusoidal waveform. It is defined as the ratio of the vector sum of all harmonic components (greater than 1) to the magnitude of the fundamental. For instance, for a voltage waveform, THD is defined by the equation:

$$\mathrm{THD} = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \cdots + V_n^2}}{V_1}$$

    where V_i is the root mean square (rms) voltage of the ith harmonic.

27. **"UUT"** means the "unit under test," which in this document refers to the combination of the battery charger and battery being tested.

Section 1604. Test Method for Specific Appliances.
(y) Battery Charger Systems.

[insert Battery Charger Systems Test Procedure v1.1: http://www.efficientproducts.org/reports/bchargers/1577_EnergyEfficiencyBatteryChargerSystemTestProcedure_V1.1_FINAL.pdf]

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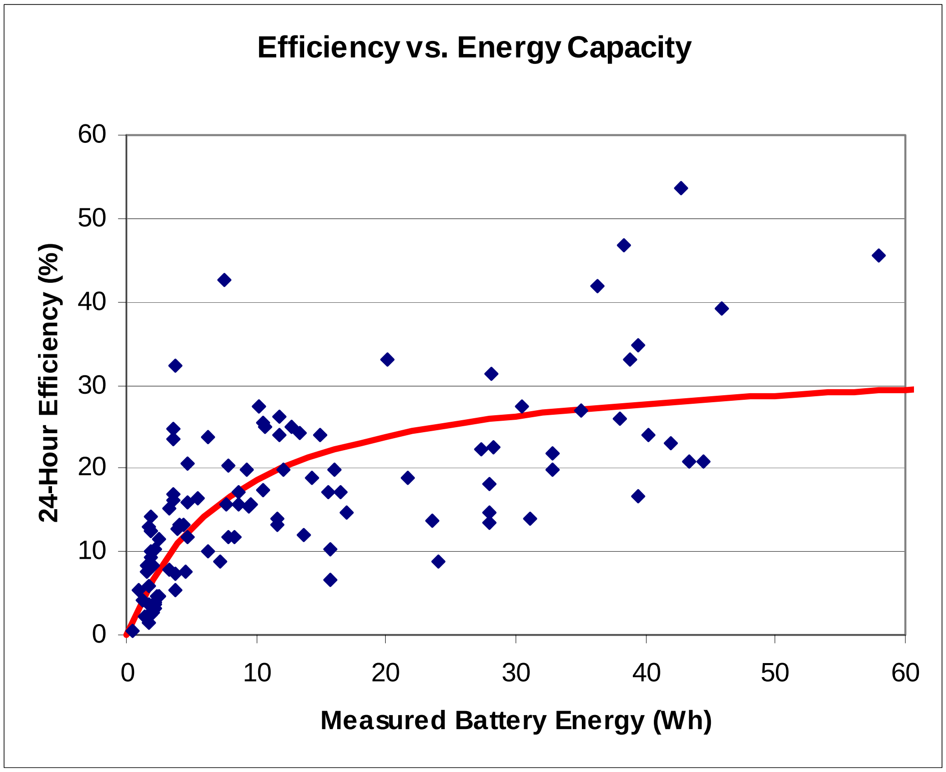
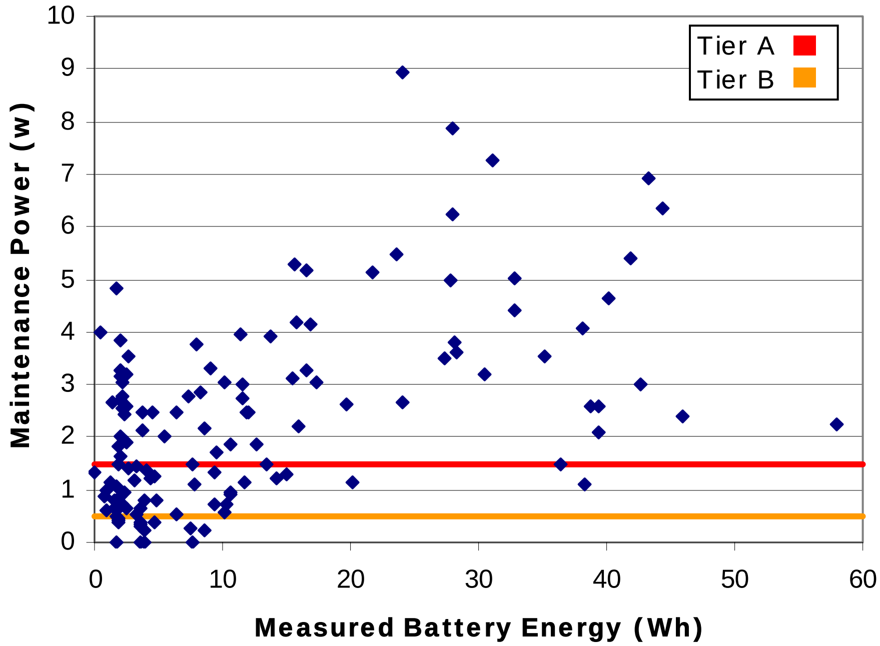
World Switch Mode Power Supplies Market. Frost & Sullivan: 2003. Telephone: US (415) 961-1000; London 071 730 3439

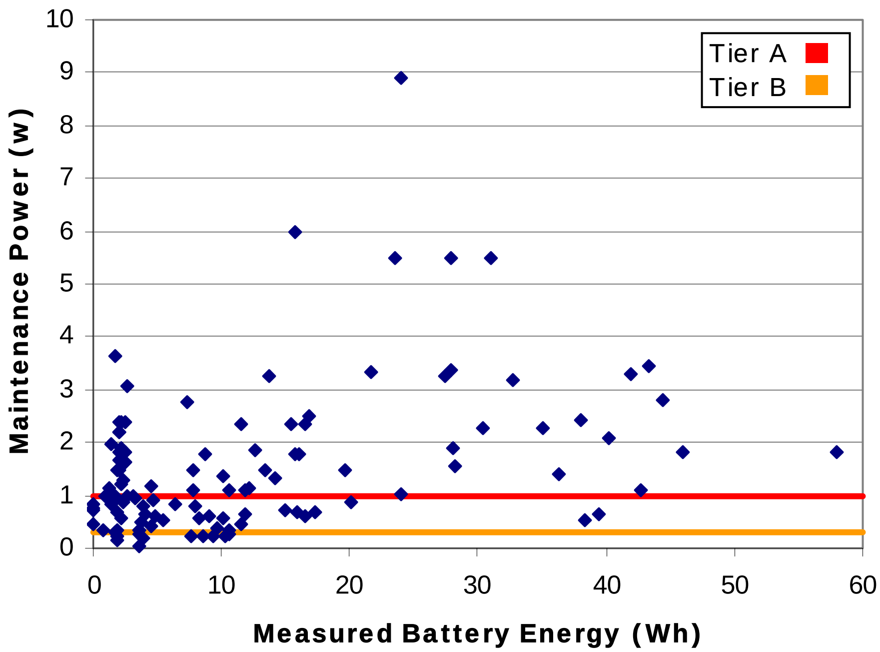
Appendices:


Efficiency vs. Energy Capacity
24-Hour Efficiency (%)
Measured Battery Energy (Wh)
0
10
20
30
40
50
60

Maintenance Power vs. Energy Capacity



No Battery Power vs. Energy Capacity



Draft Call for Battery Charger Test Data

The California Energy Commission requests manufacturers and other interested parties to submit test data on battery charger systems. As discussed at the Energy Commission Scoping Session on January 15, 2008, and at the Battery Chargers Test Methods Meeting on April 8, 2008, this data will be used to characterize the battery charger products currently available in the marketplace and to inform the development of efficiency standards for battery charger systems. All battery charging products with a single-phase ac input power up to 2kW are of interest. **The Energy Commission will consider all data submitted to [NAME], at [email address] by May 16, 2008, when establishing the proposed qualification levels for battery charger efficiency standards.** Interested manufacturers are encouraged to reply to [name given above] as soon as possible regarding product types they wish to test for this effort and read on for further information. Upon receiving word of a manufacturer's interest, the Energy Commission will distribute data collection forms as appropriate.

Tests should be conducted in accordance with the Energy Efficiency Battery Charger System Test Procedure available at:

http://www.efficientproducts.org/reports/bchargers/1577_EnergyEfficiencyBatteryChargerSystemTestProcedure_V1.1_FINAL.pdf

Test results should be submitted to: **XXX**.
Questions regarding the Test Procedure or data submission should be addressed to: **XXX**.

Thank you for your continued support of California' energy efficiency standards development process.

Notes to accompany data collection form:
Please submit results on the spreadsheet template located at:

http://www.efficientproducts.org/reports/bchargers/BatteryChargerTestTemplate_20Mar08.xls

Each line should be used for a separate test. Some battery chargers require 2 or more tests as detailed in the Test Procedure and will therefore occupy multiple lines. Explanations of the required entries are in the Test Procedure. Numerical values should be entered just as a number using the units specified in the column heading. (Any units or other characters in the data cell make it more difficult to plot or calculate with the data.) Ratios (such as power factor, crest factor, or efficiency) should be entered as decimal fractions, not as percentages. Comments may be entered in the appropriate cells or the cell may refer to comments submitted in an external document. Column headings marked by a red asterisk are not required by the Test Procedure but would be useful for the data analysis if the information is available. *Note: Although the Test Procedure is designed for single phase systems, stakeholders are also invited to provide comparable test data for three-phase battery charger systems.*