Responses to Comments Received on the 5/21/2007 Working Draft Battery Charger Test Procedure

Paul Bendt, Ph.D.
Ecos Consulting

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After publishing a preliminary draft test procedure for measuring the energy efficiency of battery charger systems in mid-2003, Ecos Consulting has held stakeholder workshops, collected public comments, and made revisions to three subsequent drafts. The following document gratefully acknowledges receipt of comments on the 5/12/2007 draft, and provides responses indicating how and why various portions of the test procedure were changed, or were left unchanged, in the final draft published in September 2007.

Seven individuals or organizations submitted comments on the 5/12/2007 Working Draft Battery Charger Test Procedure. One set of comments referred to previous comments submitted by the same organization; the previous comments are included here as if they had been attached to the subsequent submittal.

One set of comments was in the form of a marked up copy of the test procedure. Numerous proofreading and editing corrections are appreciated and have been incorporated. The substantive comments are numbered, summarized, and addressed here.

This document is organized in three major sections.

I. Comments received that do not address the content of the test procedure itself. This includes comments on issues such as hypothetical future energy policies by various jurisdictions.
II. Comments that address substantive and specific changes to individual steps or wording of the test procedure.
III. Broader comments on the scope or methodology of the test procedure.

Section I. Comments Pertaining to Possible Future Policy Based on the Test Procedure

Note: The purpose of the test procedure is to accurately measure the energy efficiency of battery charging systems. Once those measured data are collected, analyzed, and used to inform future policy proposals, comments to policymakers on the merits of those proposals would be appropriate. The scope of this document is limited to the technical merits of proposed changes to the test procedure, not policies that may be considered in the future.

1. We are concerned that a regulation based on this type of test procedure will not even save a reasonable amount of energy because this procedure measures the wrong things.

Response: We are not aware of significant energy use by battery chargers other than when they are in active, maintenance, no-battery or off modes. If this test procedure has missed another type of energy use where significant savings are possible, please include specific information in future comments.

2. Data that was presented as a justification for potential battery charger regulation was based upon measurements of products including wall adaptors from before the CEC EPS regulation went into effect. Since California chose to have this regulation apply to battery chargers, any active mode energy consumption would be presumably reduced as an effect of this regulation. The potential energy savings is therefore overstated.

Response: This does not affect the test procedure, but it is a point to consider when analyzing the potential energy savings for a proposed policy.

3. The current draft test procedure from Ecos Consulting does not explain how the data gathered in this test procedure would be used by the California Energy Commission to set regulatory requirements for battery chargers. It is difficult to react to a test procedure without understanding the outcome.

Response: This comment should be directed to the CEC if or when it convenes a battery charger standards rulemaking. The test procedure addresses product measurement, not energy policy.

4. Who does the testing? Would those manufacturers capable of doing their own testing be allowed to carry out the test procedure?

Response: The test procedure has been written to allow any entity with the proper equipment to conduct the test. Policymakers will determine whether to require third party tests or not.

Section II. Comments on Specific Sections and Wording in the Test Procedure

Battery Conditioning

5. Part V.D lines 349 to 350. In this sentence the Authors require a battery conditioning / preparation procedure if the manufacturer specifies it, however in Table A this step is described as 'optional'. The Authors may want to look at this issue in more detail and make a determination as to whether it is optional or required.

Response: Agreed. The document has been updated to make conditioning required for NiCad and NiMH batteries and is not to be done for lead acid or lithium batteries. Changes in Table A and Section VI.A.

6. The sentence in definition "E. Battery conditioning" about nickel cadmium and nickel metal hydride batteries needs to be deleted.

Response: Agreed. Definition (now III.F) modified.

7. Allowing manufacturer-specified conditioning removes consistency on how a battery could be tested. Furthermore, some manufacturer could use such a clause to specify testing conditions that would allow their product to pass when in fact a consistent method would show their product fails. Allowing the manufacturer to specify testing conditions creates a loophole. Battery conditioning should be defined and be mandatory.

> Response: Battery conditioning is now specified by the test procedure and not the manufacturer. It is mandatory for NiCd and NiNM batteries and is omitted for other battery chemistries. Changes made to Table A and Section VI.A.

Data Logging and Reporting

8. Part VI, line 408. The Authors require a sampling rate of voltage and current of at least once per minute. With a 0.2C discharge current, the discharge process is rather slow. Perhaps, in the interest of reducing the burden while not compromising accuracy, larger sampling intervals such as ten or fifteen minutes might be considered?

> Response: Battery analyzers are readily available which provide once-per-minute data logging. While the use of such an analyzer is not required (that is, the data logging could be done manually by a technician), its use is anticipated. No changes.

9. Part VII, lines 433-435. The Authors may want to clarify exactly which energy, power, and power factor measurements should be recorded, to eliminate any ambiguity.

> Response: Agreed. Sections VI through VIII modified.

10. We are adding a new section on sampling (integration) in IEC62301 - this is really preferable in any case, especially for this type of product that may have long period cycles. You are more or less saying that with a requirement to sample each minute, but it is worth emphasizing.

For chargers with complex patterns, you may want to sample more frequently than 1 minute, but it is not that critical. I can send you a Nokia mobile charge pattern if you want - it is very pretty.

> Response: Sections VI.D and VII have been modified to require integrated energy values for the charger input. During discharge, the battery voltage varies slowly with time, so one-minute sampling is satisfactory.

11. Line 462 - as noted above, integration or sampling is probably better than 5.3.2. In this case you may want to make it shorter than 1 minute for charging. Sampling is the only way you can connect the product and come back tomorrow and look at the data and analyze it. This is the only practical way to test this product.

> Response: The procedure has been clarified to require sampling (to get the time profile, Section VI.D) and integration (to get accumulated energy, Sections VI.D and VII). It is presumed that a data logger will be used to record the data. The one-minute sample periods are acceptable as long as

either (a) the sampled value is the average power drawn over the sample period, or (b) total energy is measured by integration. These two are mathematically equivalent. Shorter sampling time are acceptable (we use 5 seconds) but not required.

12. I would have thought that you should report the time for discharge as well in B - discharge

Response: Since we are discharging at 0.2C, the discharge times are all approximately 5 hours. Reporting the actual discharge time could be done, but does not provide new information. No change.

13. Wouldn't the charge efficiency be of interest as well? (charge in energy over discharge out) (I see you added this but the calculation is flawed I believe)

My impression of the key parameters are:
Energy storage Wh
Time to charge
Charge efficiency (out/in)
Float/maintenance charge W
No battery power W
Off mode power (if applicable) W

As mentioned above, forget THD of the current, add true power factor and crest factor (could make that recommended rather than mandatory as not all instruments can do this)

Response: (1) We would also like to know the charging time and charging energy (without including any maintenance mode time). Unfortunately, for many chargers there is no clear transition from charge mode to maintenance mode, so the technician's judgment calls would affect the reported values. By using only the 24-hour accumulated energy, we avoid the need to try to identify that transition subjectively. This approach was chosen after early manufacturer feedback on the difficulty of cleanly parsing modes of operation with all battery chargers. This provides a measure that is consistent for all chargers, whether or not they have distinct modes. No change. (2) We have removed THD and are now requiring power factor and crest factor. Changes to Sections VI.D, VII, and VIII.

14. We do not believe it is necessary to have definitions of "Active Power (P)" and "apparent Power (S)" definitions [sic]. These definitions are used only in a power quality measurement which is unnecessary and unrelated to this issue.
The definition "O. Power Factor (True)" needs to be deleted This is unnecessary and unrelated to energy efficiency We have heard statements from Pacific Gas & Electric that they are not concerned with power factors and we do not understand why Ecos is pursuing this.

Response: These definitions are used to arrive at the power factor, which is required to be reported. The power analyzers that will be used to make the energy measurements display power factor as a matter of course, so all we are requiring is that the technician write it down. Many jurisdictions may ignore the power factor, but some may choose to require power factor correction on some or all battery charger systems, given findings by EPRI and

other organizations that improving power factor reduces losses in the distribution wiring of buildings. No changes.

15. Required equipment accuracy and annual calibration traceable to a national standard should be specified. But make, model, and calibration schedule of equipment used should not be required in the submitted reports.

Response: The measurements are required to be made with a specified level of accuracy. In practice, this probably requires annual calibration traceable to a national standard. But if the lab can meet the accuracy requirements by different means, that is acceptable. This is the approach taken by the relevant IEC standards. Reporting the equipment used is simple and causes no harm, and is clarified by changes to Section IV.B.

16. In Canada, reporting requirements are part of the Regulations and such language would not be acceptable in the test procedure.

Response: Canadian policies may choose to specify their reporting requirements differently. No changes.

Comments on the 24-Hour Test Period and Extended Tests

17. Part VII, lines 448-449. The Authors do not provide guidance on how a technician would make a determination whether a battery is fully charged after the 20-hour period. Perhaps there is an industry standard or procedure that needs to be cited here.

Response: Agreed. This section has been rewritten to specify how the technician shall make this determination. See changes in Section V.E.

18. Part VII, line 449. The Authors do not specify by how long the test should be extended. This lack of guidance may impact the repeatability of the test procedure, perhaps resulting in identical chargers being tested by different technicians having different results.

Response: Agreed. This section has been rewritten to specify how the technician shall make this determination. Changes to Section V.E.

19. Part VII, lines 459 to 462. The Authors may want to provide guidance on whether UUT subject to the extended battery charging period are handled in the same manner that charging systems with the normal charging period are treated. For instance, would the extended testing period still be classifies as maintenance power in the test report, even though the technician determined that this time relates to charging?

Response: Agreed. The last four hours are considered as maintenance mode, but not the entirety of the additional time. Clarified in Section VI.F.

20. While I can see where you are coming from with the 24 hour period, I think it would make more sense to just say until fully charged plus 4 hours. A mobile phone will charge in 1 hour - why make the test drag on for 24 hours when it could be all over in 5 hours?

Response: The 24 hours is admittedly sometimes inconvenient. However, it can be quite difficult to determine when a battery is fully charged. For many chargers there is no clear transition from charge mode to maintenance mode. By using only the 24-hour accumulated energy, we avoid the need to try to identify that transition. This provides a measure that is consistent for chargers with and without distinct modes. No change.

21. Section VII: Charge Mode and Battery Maintenance Mode Test
Consider revising the language in lines 445-446 to be more explicit and state upfront that: "the measurement period shall be 24 hours for all battery-charging systems, except for those circumstances described below where additional testing time beyond 24 hours is required. The charge cycle must include at least 4 hours of battery maintenance mode and, for cyclic maintenance modes, and integer number of maintenance cycles."

Response: These clarifications (though not the exact language) have been made in Sections V.E and VI.D.

22. The test period for charging needs to be at least 24 hours. Again, this may be different for different types of battery charging products, but for appliance battery chargers, a time period of 24 hours will ensure that the battery is fully charged, and has stabilized and equalized all cells. Any less and it may be that you would be measuring other factors than maintenance or stand-by mode energy.

Response: The test period is 24 hours, or longer. This change was made to an earlier draft and is now in Section V.E.

Comments on Other Functionality

23. Part IX line 532. The Authors may want to require the technician to specify exactly what steps were taken to disable these functions, as specified in V.E. This specificity would be helpful in ensuring repeatability of test results by other technicians.

Response: Agreed. Changes have been made in Sections V.D and VIII.

Separating Charging and Maintenance Modes

24. I think you need to separately report the charge time and energy and don't bundle the maintenance input power into this figure. Changes are not large, but it will mean a bit of tinkering.

Response: Unfortunately, many chargers do not have distinct charge and maintenance modes. The charger may not have any indicators and the input power consumption may not show any clear change. The procedure was deliberately written so that a meaningful measurement could be taken when these modes are not distinct. No changes.

Note: For the tests we run, we do separate the data for each mode when they are distinct. But since this is possible for only some of the products, the efficiency metric cannot rely on the separation of charge and maintenance modes.

25. Line 553 Reporting of charge and maintenance
Looking at the test method again, you seem to be just reporting the 24 hour result. This seems to be a bad idea in my view. I think you should separate the charging part (time and energy) from the maintenance part. Just reporting a value for 24 hours does not help you estimate energy over 12 hours or 48 hours from the information. If you are sampling data at 1 minute for 24 hours then this is not problem to separate the charging part from the float part.
If, for example, you knew that it charged in 4 hours and used 33 Wh, and then went to a float charge of 2.1W, you could work out the energy for any user profile.

Response: See comment above. No changes.

26. The charge efficiency you calculate includes a whole lot of float time energy which does not make any sense to me. In this sense, the whole 24 hour test period is completely arbitrary.

Response: See above. No changes.

27. Part IX, line 577. The procedure is actually calculating the efficiency of the battery charging system in both the charging and maintenance mode (since this calculation calls for the battery discharge energy (B1) to be divided by the accumulated charging energy (C1). Therefore, the Authors may consider clarifying the efficiency term to be "Charging and Maintenance Efficiency" as opposed to simply "Charging Efficiency."

Response: Agreed. The change in terminology is now in Section VIII.E and elsewhere.

28. G Battery Maintenance Mode
We discussed this mode and agree that this is a relevant mode under IEC62301.

Response: No action needed.

29. Consider whether further delineation between active mode and battery maintenance mode is feasible. Currently, the battery maintenance is defined as the state where the battery is "at or near 100% capacity," which seems a little vague. Has any research been conducted to determine whether an industry definition exists of when a battery is considered fully charged? We recommend this change/research in order to limit subjective determinations by lab technicians of when the battery maintenance mode begins and any related test repeatability issues.

Response: We agree that repeatability is crucial and have revised Sections V.E and VI.D to remove the subjective determinations. However, we have taken a different strategy. To respond to the suggestion, yes, there are accepted procedures to determine that a battery is "fully" charged and it is therefore possible to separate active mode from maintenance mode. For some battery charger systems, it is as easy as observing an indicator light. For others, it can involve very substantial testing. In order to make the delineation reliably and repeatable would require a test procedure that is much longer and more complicated.

The strategy we have taken instead is to design the procedure so that a delineation between charging mode and maintenance mode is not necessary.

The vast majority of products will get a 24-hour test and at least the last 4 hours will indeed be maintenance mode. For the few that get longer tests, the test length is now determined unambiguously by Section V.E. A very few products will still have some charge mode in the last 4 hours; that will simply make the maintenance mode power appear higher. While a policy may penalize these very few products for their high maintenance mode power, a manufacturer can avoid the penalty by including reliable charge times in the user instructions. Then the product will be included in clause V.E.2 and the longer test duration will assure that the true maintenance mode is being measured.

Comments on No-Battery and Standby Modes

30. M No Battery Mode. Under the new IEC definitions, this would be a type of off mode (but call it no battery mode). However, it is conceivable that a charger may also have a separate off mode if there is a switch on the product, which could be a lower mode than just the battery or device disconnected. While this is probably not that common, it is quite possible. So I would add a separate off mode (see below - you already have as standby mode) and leave this mode with batteries or device disconnected. (this would replace your "Standby mode" - I would not call it that - see T)

Response: The definitions and measurement procedures for no-battery mode have been clarified. Standby mode has been replaced with "off" mode, which is similar but defined slightly differently. See changes in the definitions and Section VII.

31. [No-Battery Mode]: I would delete "dc" as you say elsewhere the output can be DC or AC.

Response: Agreed. Definition changed.

32. [No-Battery Mode]: "Ideally" is not a word you would normally use in a test procedure!

Response: Agreed. It has been removed.

33. [No-Battery Mode]: I am glad you deleted the rest of that clause as that was not helpful.

Response: None needed.

34. T standby mode - a new off mode could be: (to replace standby mode T)

Off Mode
off mode is where the product is switched off using a switch located on the product, if applicable, while connected to a mains power source and used in accordance with the manufacturer's instructions.

I would not use the term standby mode as this will create all sorts of confusion. The switch may be hard or soft - it does not matter - a switch is a switch. There is one (in which case off mode is applicable as well) or there is not, in which case only no battery mode is applicable.

I am not sure if you want to add it, but we defined a disconnected mode in IEC as well - see below

Disconnected Mode
This mode defines the status in which all connections to mains power sources of the energy using product are removed or interrupted.

Note: Common terms "unplugged" or "cut off from mains" also describe this mode.

There is of course no measurement in this mode but it is perhaps a helpful reminder that this is a relevant mode in terms of a full duty cycle and is certainly relevant to a lot of products like mobile phone chargers.

Response: As recommended, standby mode has been removed and replaced with "off" mode. See changes in the definitions of modes and in Section VII.

35. C Standby power - call this off mode and note that it is only relevant where the[re] is a switch on the product.

Response: Same as above comment.

36. Consider changing the term "hard-off" on line 212 to simply "off", since either a hard-off or soft-off could potentially put the charger in a lower power mode than no-battery mode. In addition, contact and solicit input from ... who is leading work on amendment 1 to IEC 62301-2005 to avoid and confusion or terminology issues related to standby and off modes.

Response: The definitions have been clarified. See above comments.

37. Table A - no battery mode should be in line with new IEC requirements - 30 minute stabilisation and 10 minute reading period.

Response: Agreed. Changes in Section VII.

38. VIII no battery test
Another good example would be a mobile (cell) phone or a laptop - the device is attached and detached from a power supply.

Response: None needed.

39. I would suggest a longer stabilisation period and reading period (new IEC say 30 min stab plus 10 min reading) if you are going to permit 5.3.1. But I am not sure you should really be encouraging this method.

Response: Agreed. Changes in Section VII.

40. [No-Battery Mode] I can imagine that there may be some products where this mode is not relevant - for example which has a main power inlet (batteries can't be disconnected without disconnecting the mains)

Response: True. No changes needed.

41. Consider adding the standby test to Table A.

Response: Agreed. It is now called "Off" mode and is in Table A.

42. The definition "M. No-Battery Mode" needs to be brought into alignment and harmony with the definition in the EPA Energy Star test procedure for battery chargers. There is no reason to have a different definition.

Response: The Energy Star test procedure defines and measures a "maintenance mode" and a "standby mode." Because many chargers have multiple low-power modes (more than just the standby mode defined by Energy Star) and because many chargers spend a large fraction of the time in these various low-power modes, commenters have suggested that the test procedure measure more than just the one "standby" mode. The result is both the "no-battery mode" and the "off mode," with clear descriptions of which measurement(s) apply for a given charger and how to set them up. This provides information that the Energy Star procedure omits.

43. Test Procedure [draft #1] line 305 contains an error. It would be inaccurate to state that all electric razors/shavers do not have a "no-battery" condition.

Response: Agreed. The wording now reflects that many shavers do not.

44. The test procedure needs to be re-configured to better approximate the full measurement of both no-load and battery maintenance conditions. [Referred to draft #1.]

Response: Full measurement of these modes is now required, Section VII.

45. Section VIII.B. Should provide one specific test method. Any tester should be able to follow the procedure step by step and replicate the original test. Giving two options is not acceptable.

Response: Agreed. The integrated energy test will become the requirement. See changes to Sections VI.D and VII. However, even so, one cannot truly replicate the original test. Batteries are complex chemical systems, and do not perform identically under identical conditions.

Comments on Which Batteries to Use for Testing

46. Section V: Battery Charger System Setup Requirements
Under 'Guidance on Battery to Use for Test," consider indicating whether measured or rated capacity should be used when determining the highest and lowest capacity batteries. When developing the current ENERGY STAR Test Method, stakeholders commented the manufacturers who rate their batteries conservatively may be at a disadvantage. In response, EPA changed the test methodology and specification to refer to battery energy and provided instructions for measuring it at a constant discharge rate of 0.2C in order to be consistent with applicable IEC standards (e.g., Clause 7 of IEC 61951 and IEC 61960).

Response: We are specifying that it is the highest and lowest *rated* capacity that determines which batteries to use. In most cases, all the batteries being considered are made by the same manufacturer as the charger, so even if the

manufacturer rates batteries conservatively, the ranking should still be correct. It would be excessively burdensome to require measuring the capacity of all candidate batteries, just to determine which ones to use. But once a battery is selected and the efficiency is being calculated, we require use of the *measured* battery discharge energy, measured using the same procedure as IEC and EPA. See changes in Section V.C.

47. In addition, the language for chargers with "multiple types of batteries" requires batteries that are "sold with or associated with the charger", while chargers with multiple charging ports use batteries "that the charger is meant to accommodate". It is not clear why this distinction is made for the two different types of charger and further the term "associated with" seems vague and should be clarified. For consistency, consider revising the test to require that all chargers be tested either with the products they are sold with or with the highest and lowest capacity chargers [sic, probably means batteries] they can accommodate.

Response: Agreed. This section has been rewritten to clarify the term "associated with" and to use it consistently. See changes to Section V.C.

48. On page 9, Line 309 [of Draft #2], Ecos has suggested that "the battery charger shall be tested with batteries that are most closely associated or typically used with the product." We do not understand the term and believe it is far too vague for a test procedure. The test procedure should specify that the battery charger be tested with the batteries referenced in the manufacturer's instructions.

Response: Agreed. See above comment.

Comments on Access to the Battery

49. [We] are very concerned about the proposal to have a testing laboratory open battery packs and battery operated appliance containing batteries in order to measure the energy used. Many manufacturers provide specific warnings about the hazards of opening these enclosures. They specifically don't provide servicing information to discourage consumers from engaging in these activities. The proposed test procedure would require manufacturers to violate their own admonitions and provide public agencies with this information. In addition, it would require manufacturers to reveal proprietary information regarding there circuitry and interface to public agencies. This information would presumably be publicly available.

Response: All battery charger test procedures to date measure the actual energy stored in the battery using a constant discharge current. They require some form of access to the battery terminals to conduct this measurement. This procedure is no different, though perhaps it is the first to be explicit about the required access.

Accessing a battery is not inherently dangerous, for either a technician or a consumer. The test procedure does not require that technicians open "battery packs," because the task at hand is to measure the energy stored in the entire battery pack, not its individual cells.

A tremendous variety of consumer products are sold with replaceable batteries of every chemistry and a wide range of types, styles, and capacities.

Manufacturers' reasons for sealing a small fraction of them may be safety, aesthetic, or financial concerns. The *consequences* of sealing them are to eliminate the ability to measure a product's efficiency and require consumers to discard a functioning product when its rechargeable battery fails.

Test procedures are all focused on obtaining consistent results. Manufacturers have an interest in ensuring good measurements. The access instructions that may be necessary for carrying out this test procedure are being provided to trained technicians working in certified labs, not to the average consumer. Any manufacturer who objects to providing the information can avoid the problem by labeling their batteries clearly and making them easily accessible. The rest of the product can still be sealed, as long as the battery is accessible to a trained technician without rendering the product inoperable.

This section has been clarified; see definition of "Instructions" and Section V.F.

Suggested wording to remove ambiguities and make document clearer.

50. Part I, lines 40 to 41. The Authors may want to clarify whether "nameplate ac rating of less than 2kW" references the input or output of the unit under test.

Response: Agreed. Section I modified to specify input power.

51. Part II lines 76 and 84. The Authors are referencing outdated industry standards. The Authors may want to obtain the current standards and update the references, if appropriate.

Response: Agreed. Updated standards have been consulted and referenced in Section II. No changes to the procedure were found to be necessary.

52. Part III. The Authors may consider revising some of the definitions to remove language or statements that are potentially illustrative or procedurally instructive. For example, Active Power – the second sentence: Battery Conditioning – the second sentence; Battery Rest Period – the last sentence; C-Rate – the second sentence; No Battery Mode – the second sentence; Measured Energy Capacity – the second and third sentence; Rated charge Capacity – the second sentence; Rated Input Frequency – statement after the semicolon; and Rated Input Voltage – statement after the semicolon.

Response: Agreed. The sentences referred (and others) have been removed or placed into clarifying notes. Section III modified to incorporate the suggestion.

53. Many sentences and paragraphs contain non-mandatory language and are there to inform the reader only. These should be removed or considered as "notes" and appear as such.
[The commenter provided numerous specific instances which are not listed here.]

Response: Agreed. These changes are made throughout the document.

54. Part III, line 226. The Authors may want to specify the number of harmonics included in the THD calculation. The Authors may consider harmonics up to the 13^{th}, as this would be a number consistent with the External Power Supplies Test Procedure, August 11, 2004 (page 4).

Response: Agreed. This also makes the procedure consistent with IEC 62301. Section IV.D changed to include the suggestion.

55. Part IV, lines 235-236 and line 240. The Authors may consider making the test sequence 'required' rather than 'suggested', to ensure more accurate repeatability of test results.

Response: Agreed. Section IV.A modified.

56. Throughout. Acronyms such as "AC" for Alternating Current and "RMS" for Root Mean Square should be capitalized.. (N.B. authors capitalize IEC, IEEE, UUT, VA, THD)

Response: The IEEE style guide specifies that "ac", "dc", and "rms" should be lower case. While there may be different style preferences, we do not believe this creates any confusion in applying the test procedure. No changes.

57. Part I, lines 39 to 41 and lines 45-47. The Authors may want to review whether these two sentences on the scope and application of the test procedure are compatible. Lines 39 to 41 state "This scope is meant to cover ... single-phase voltage and have a nameplate ac rating of less than 2 kW." Lines 45-47 state "This test procedure may also be used for battery charging systems which use a dc input power source."

Response: Agreed. Document is clarified to cover systems with an ac or dc input of up to 2 kW. Section I modified.

58. Part II. The Authors may want to alphabetize the references, or perhaps order them by technical citation first (e.g., IEC 62301) since this is how they are referenced in the document.

Response: Agreed. References are now in citation order, Section II.

59. Part II, line 71. The Authors may want to note after "IEC 62301" that this is Edition 1.0.

Response: Agreed. Section II modified.

60. Part III, line 229. The Authors may want to clarify the language by inserting the phrase' combination of the' so it reads: "refers to the combination of the battery charger and battery".

Response: Agreed. Definition III.AA modified.

61. Part IV, line 227. The Authors may want to revise this statement to improve the readability and clarity. Perhaps replacing 'under per' with 'according to', so it would read: "batteries shall be stored according to the requirements ..."

Response: Agreed. The rest period requirements have been moved to Section VI and clarified.

62. Part VIII, line 489, 498 and 507. For clarity of presentation, the Authors may want to provide the charger configuration instructions in the text, and only make reference to the section (e.g., VIII.A or VIII.B) in the flow diagram.

Response: The information has been included in the text, and the flow diagram modified for clarity.

63. Part VIII, lines 516 and 517. The IEC citation given is "63201" and should be "62301".

Response: Agreed. Typographical error has been corrected.

64. Part IX, line 555. The Authors may consider clarifying that the total accumulated energy over the course of the test is the measured cumulative energy consumed by the battery charger rather than the energy accumulated in the battery.

Response: Agreed. Section VIII.B has been modified.

65. Part IX, line 570. The Authors may consider requiring the reporting of the Average standby mode power in watts, regardless of whether the numerical value is the same as the average no-battery mode power or not. This would ensure the data point is captured for all chargers, irrespective of their classification.

Response: Agreed. Sections VII and VIII modified.

66. A Active power. I don't think you can add "sampling" to this IEC definition - it really is intended to mean a single AC cycle (which is why it is of limited value)

Response: Agreed. Definition III.A modified.

67. B Ambient air temperature. I would delete "immediately" - that could be misunderstood to mean very close to the device.

Response: Agreed. Definition III.B modified.

68. O Power Factor
This definition of power factor includes the effect of both harmonic distortion and phase angle displacement between the current and voltage.

Response: Agreed. Suggested wording has been added to definition III.S.

69. Suggest spelling out VRLA on line 258 for Consistency

Response: This section has been rewritten and the abbreviation not used.

70. We ask Ecos to consider using appropriate terms in some applications. A "no-battery" mode is not the same as "stand-by" mode.

Response: Agreed. These modes have been clarified in Sections III and VII.

71. Lines 41-45; the definition of the commercial sector should be in the definitions section.

Response: In response to other comments, we have removed any reference to market sectors, so the definition is no longer needed.

72. CSA uses a different nomenclature for references. Also they should be alphabetized.

Response: References are now in alphabetical order by citation, Section II modified. While every entity will have different preferences for nomenclature, we believe that this causes no ambiguity in the test procedure.

73. Is the power factor definition based on Real or Active power? The terms should be defined and used consistently.

Response: Agreed. The document now uses the term "active power" only.

74. If the sequence in Table A is not mandatory, it should not appear. Consider making it mandatory to assure repeatability of the test.

Response: Agreed. Section IV.A modified to make Table A mandatory.

75. References to sections within the test procedure should be consistent, either by section name or preferably by section number.

Response: Agreed. References are now by section number, though sometimes the name is also included for clarity.

76. The test procedure should be a stand-alone document. All requirements such as test equipments, test conditions, and procedures should be specified [rather than be included by reference to other documents].

Response: Agreed. These specifications have been incorporated into the document by changes in sections IV through VII.

77. The term "guidance" is not a mandatory term, leaves the impression that the tester can do what he wants.

Response: Agreed. The test procedure is changed to use mandatory language and the term "guidance" is no longer used.

Miscellaneous Comments

78. Part IV. The Authors employ a method for harmonic analysis that is widely used when specific harmonics are significant. It also provides reasonably accurate THD data, but the task of determining and summing the significant harmonics is time consuming, and the Authors may consider specifying a THD analyzer.

Response: Measurement of THD of the input current has been eliminated. The specification for clean input power still includes a THD limit. It is not necessary to measure and sum the individual harmonics if one uses an instrument that performs the calculation internally. We would recommend that the lab use a THD analyzer, but it is not required as long as lab can demonstrate that its power source meets the THD requirement. Changes in Sections IV, VI, VII and VIII.

79. Part IV.C lines 257 to 261 and Part IV.G lines 294 to 298. The Authors do not specify equipment or rest periods for Rechargeable Alkaline batteries.

Response: No special equipment is required. The rest periods for NiCd batteries are also suitable for rechargeable alkaline batteries. Rest periods are now specified in Sections VI.C and VI.E.

80. Part VI. The Authors provide guidance on the overall accuracy of controlled and measured values associated with discharging the battery in Section IV.C (lines (254-268), however it is unclear whether the referenced industry standards provide any guidance on the means to terminate the discharge at the voltages specified in Table B. The Authors may want to provide some additional explanation or direction on this issue.

Response: The requirements have now been incorporated into this test procedure, so reference to external documents is not necessary. We recommend that the discharge test be done with a battery analyzer which can be set to automatically terminate the discharge at a specified voltage. But the lab is allowed to use any other method that works. See changes in Section VI.F.

81. Part IV, just above line 241. The Authors may want to revise the Approximate Test Times, which overstate the Technician Time by 33%.

Response: We have removed the Technician Time estimates completely, since they didn't provide any additional information as to the required procedures.

82. U THD
You need to be a bit careful here as we are talking about AC waveforms. .
I may be wrong, but I seem to remember that AC waveforms only have odd harmonics (ie 1, 3, 5, 7, 9 etc) so while your equation may be correct, in practical terms 2, 4, 6 etc will be zero (unless perhaps there are significant DC components, which would be rare). Anyway, better check with someone who knows what they are talking about.

In terms of the test procedure, we are only interested in THD of the supply voltage (ie to make sure it is clean). The current waveform will always have lots of THD (nothing these days is a sine wave) but that is not a lab condition, it is what the product uses. So you need to make sure that you link THD to supply voltage (not current). You have introduced current THD in the latest draft which I think makes no sense.

Response: We are interested in THD for two reasons. The first is to have a clean input supply voltage, and the only requirement here is that it be clean enough, not more than 2% THD. The second does have to do with the current drawn, as high current pulses can lead to large resistive losses in the grid supply wiring. While the THD of the input current give some indication of these losses, a better measure is the current crest factor. The procedure now requires reporting of the crest factor instead of the THD, changes in Sections VI, VII, and VIII.

Note: The even harmonics can be present and represent an asymmetry between the positive and negative half-cycles. The dc component is the zero-th harmonic. Power supplies with a full-wave bridge rectifier usually have very small even harmonics, as they are caused only by imbalances between the rectifier diodes.

83. VII Battery Maintenance Mode
Point 6 & 7 - there is no point in recording the THD of the current waveform as noted above. This is difficult and expensive to measure - most digital power analysers do not have this function - you need to spend min $5k and more like $10k to get an instrument to do this accurately. What is the purpose? It is a reading of absolutely no value or interest to anyone. Record the true power factor and crest factor of the current waveform, which are of interest, but forget THD of the current.

Response: Agreed. Changes made to sections VI, VII and VIII.

84. I imagine some chargers go into a steady state float charge while some may go into a state of top up then disconnect in a cycle, so there may be some pattern of cycling. So you may want to flag that where there is cycling that a whole number of cycles over not less than 4 hours are used to determine the average power for maintenance.
See comment below on separation of charge and maintenance (in reporting).

Response: Agreed. Incorporated in changes to Section VII.

85. As per some of the comments, it seems that large scale lead acid batteries are not well addressed in the procedure (normal charge vs occasional equalisation charge)

Response: The document is specific that only the energy consumed during the normal charge cycle needs to be measured, not the equalization cycle. This is clarified in Section IV.A.

86. In Table B, the end-of-discharge voltage for Lithium Ion batteries should be 2.5 volts per cell. This is consistent with IEC 61690.
In Table B, the end-of-discharge voltage for Lithium Ion batteries is still listed as 3.0 volts per cell. In today's world of Lithium Ion batteries, with different cell chemistries, this is inaccurate. Because of different chemistries, the Ecos test procedure should list the end of discharge voltage according to the value recommended by the manufacturer.

Response: The end-of-discharge voltage for Li-ion batteries has been changed to 2.5 V per cell to be consistent with IEC 61960. In practice, this is not significant since modern Li-ion batteries have very little extractable energy between 3.0 V and 2.5 V. Table B modified.

87. A battery charger is not the "box on the end of the cord that plugs into a receptacle" but a combination of integrated elements. Statements such as Lines 26 or lines 296-297 [of draft #2] seems to indicate that Ecos still does not understand the functions of or mechanisms of design of a battery charger.

Response: Different types of products often package the elements of the battery charger system differently. The lines referred to are correct descriptions for some types of packaging. These statements also correctly acknowledge that, for other types of packaging, they may not be applicable. Clarification added in Section V.A.

88. The definition of "I. Charge Mode" needs to be modified to read "Active Mode." It seems unnecessary to refer to the same element by different names.

Response: The term used consistently throughout the document is "Charge Mode" and the term "Active Mode" is not used. We will continue with the term Charge Mode because it is more specific (especially for battery chargers that are components of products having other functionality and other active modes). No changes.

89. The definition "T. Total Harmonic Distortion (THD)" is not necessary along with the resultant testing. This is already referenced in IEC62301.

Response: The definition is used to define the quality of the Input Reference Source Section IV.D. While we recommend that labs have a copy of IEC 62301, we are also writing this test procedure to be a stand-alone document. No change.

90. The standard calls for a five hour discharge. The typical discharge rate for US manufactured motive power lead acid batteries is at the 6 hour rate.

Response: IEC 60254-1 for lead acid traction batteries calls for a 5-hour discharge both for stating nominal capacity (section 3.1.2) and for measuring actual capacity (section 5.2). Since a 5-hour discharge is also specified by the IEC for most other battery types, it was decided that it should be the standard for this test procedure. In any event, a 5-hour discharge will not harm a lead-acid traction battery and can be used as consistent standard of comparison for the purposes of this test procedure, regardless of how the batteries might be tested for some other purpose. No change.

91. Is there an IEC standard for rechargeable alkaline batteries?

Response: Not to our knowledge. No changes needed.

92. Section IV.D. Required tests should be conducted at ambient temperature. The technician can do as many other tests, under any other temperatures or conditions as he wishes, but that should not be part of the test procedure.

Response: Agreed. Clarification added to Section IV.C.

93. Section V.A. If no EPS is provided, then what.?

Response: This section has been clarified. The presumption is that any charger which uses an EPS will be packaged with one or have one available as an accessory. If not, then it should be considered as a dc (or low-voltage ac) powered charger and should be tested with an appropriate lab-grade power source. Regardless, the input voltage and frequency are part of the report, so it will be clear how the test was conducted. See clarifications in Section IV.D.

Section III. Comments on Scope and Methodology

Comments on the Scope of Products that can be Tested with the Test Procedure

94. Section I: Scope
Consider removing references to specific sectors (i.e., "This scope is meant to cover battery charger systems that operate on single-phase voltage and have a nameplate ac rating of less than 2 kW. This test procedure also may be used for battery charger systems that use a dc input power source.") Since it appears that products with residential, commercial, and some industrial applications are covered by the test procedure, it doesn't seem necessary to define the sectors and potentially limit the procedure's applicability. It is preferred to define scope based on technical characteristics rather than market segments.

Response: Agreed. Section I modified to reflect suggestion.

95. We believe it is extremely important, if not crucial to our industry, that there be a separate test procedure and standard within California Title 20 to deal with appliance battery chargers. We must reiterate our belief that battery chargers should not be tested to an External Power Supply test procedure nor be required to meet the standards applied to constant voltage power supplies.

Response: For this test procedure, it does not matter whether the battery charger has an external or internal power supply. It also does not matter whether the power supply (internal or external) is subject to any other energy policy. This test procedure is suitable for appliance battery chargers. It tests the battery charger system as a complete system and not as an EPS. Concerns about possible standards under Title 20 should be addressed to the policymakers at the appropriate time. No changes needed.

Note: Some battery chargers do use an external power supply, while for many others the power supply and the charge control circuitry are in the same enclosure. This procedure is suitable for either type.

96. Comments such as the one found on Line 267-268 of the [first] Draft Test Procedure seem to indicate that there is such a thing as a separate battery charger and external power supply. This is not the case with appliance battery chargers. There is one battery charger.

Response: Some battery chargers do use an external power supply (such as most cordless phones), while for many others the power supply and the charge control circuitry are in the same enclosure. This procedure is suitable for either type. See above comment. No changes needed.

97. We believe there are some fundamental flaws in this proposed test procedure, as it applies to appliance battery chargers, mostly due to an attempt to have this test procedure apply to such a wide range of products. ... It would be more appropriate, technically accurate, and understandable to have a test procedure for such a wide variety of products split up. A general section (we have referred to this as a "part 1") could include common elements. A specific part 2 section could be written for appliance battery chargers. Then a separate Part 2 could be written for completely different types of battery chargers (i.e. industrial, construction, commercial, etc.)

Response: We have found that the battery charger systems covered by the Scope are fundamentally quite similar. While there are differences in the products they power, how they are packaged and internal details, still all the chargers perform the same basic functions. The test procedure is written to test those common functions. We believe the procedure is appropriate for all products in the Scope and that many separate procedures are unnecessary. No changes.

98. A test procedure that encompasses such a wide variety of products and golf cart, back up emergency egress lighting, industrial floor scrubbers, and portable household vacuum cleaners is not appropriate.

Response: We disagree. All of the products listed have elements in common and it is those common elements that we are testing. In the scope of this testing, any unit that is powered by single phase 120 V and charges a battery, be it a golf cart, lighting, etc, fits the profile of a single-phase battery charging system. No changes.

99. The "Scope" states this procedure applies only to whole battery systems. If I sell a 2 kW single phase charger without a battery am I affected by this test procedure? (according to the scope, chargers sold alone should not be considered a system and as such do not fall under the test procedure)

Response: The test procedure is intended to apply to battery chargers sold with or without batteries. By definition, battery chargers are to be used to charge batteries, and part of the specification of a battery charger is a definition of what type of batteries it is designed to charge. The system, comprised by the battery charger and the batteries it is designed to charge, is the system to be tested under this procedure. It is immaterial whether this system is constructed by the consumer or is packaged and sold as a system by the manufacturer. Section I modified to clarify this issue.

Note: Each of the following comments advocates for the exclusion of some class of products from the test procedure. In each case, we believe that the test procedure is a suitable procedure for measuring the efficiency of that class of product. We are therefore declining to exclude them from the scope of the test procedure. How they will be treated by policymakers is a completely separate question, on which the test procedure will remain silent. Commenters should direct these comments to the policymakers as appropriate.

100. One of the new proposals in this Draft #3 test procedure is the inclusion of DC input battery chargers. We do not understand how this relates to the reduction of energy from power utilities, or a consumer's utility expenditure if the only DC input to battery chargers is from automobile cigarette lighter plugs. (The photograph in the Web Seminar was clearly of a 12V DC input charger.) While we understand the interest on the part of CEC to reduce overall energy consumption, we don't understand the scope to include automobile energy.

Response: We believe that the test procedure can be used to measure the efficiency of dc-input battery chargers accurately, and have therefore included them in the scope of the test procedure. Each jurisdiction will decide on the scope of their energy policy and may or may not include dc-input chargers. Having them in the scope of the test procedure does not mean that they will be subject to policy. Also there are an increasing number of dc-powered devices that do place a load on the grid, such as those powered through USB ports, UPS systems, etc. No change.

101. "Cord-cordless" appliances
These appliances use a battery charger for powering the product directly from the power cord if the battery is completely drained, or if the consumer wishes. This measurement has no relationship to a battery charger and this energy usage should not be measured. At other times the battery charger is used to recharge batteries. Because of the wide variety of these products, their usage, and the time in both applications, we urge CEC and Ecos to exempt these products from the test

procedure until a test procedure applicable to these products is written. This should be stated in the test procedure.

> Response: We agree that power used by the final product is not to be measured as battery charging energy. The test procedure specifically states that any functionality other than battery charging is to be turned off while the charging energy is measured. There may eventually be test procedures and policies relating to the energy consumption of these products in their entirety. But for this test procedure, only the battery charger system portion of the product is being tested. With this limitation, an exemption is neither necessary nor appropriate. No change.
>
> Note: In the first sentence, the commenter uses the term "battery charger" to refer to a component which must actually be a power supply, since it is not charging a battery.

102. The procedure does not address infrequently charged products, inductively coupled, and less than 2-watt products.
We classify our rechargeable and cord/cordless home use beard and mustache trimmers and face shavers to be infrequently charged products. Our marketing research has shown that people do not leave our products plugged in but will charge the trimmer and then place charger in a drawer or cabinet until the trimmer is discharged. Under normal use a trimmer will last 2-3 weeks on one charge. There are several reasons why people do not leave the product plugged in:
a. They don't like the clutter on the counter
b. There is not enough room
c. The outlets are being used for other appliances such as curling irons and hair dryers.
d. If someone wanted to mess with the cord every time they used the product they would have bought a corded one, as they are usually cheaper.

> Response: These products are appropriately included within the scope of the test procedure because they charge batteries. Like many other products, the products referenced by the commenter may be capable of performing other functions and may be used infrequently to charge batteries. Neither comment changes the test procedure's applicability to measuring how efficiently these products charge batteries. No change.

103a. Inductive charge appliances
These appliances, because of the need to maintain safety near wet environments and cleanliness, need to charge without using metal contacts. These products charge by inductive current through the plastic appliance housing and should be exempt from regulations. This should be stated in the test procedure.

103b. Inductively coupled products also need to have some type of special provision, which gives them exemption in the test procedure. These appliances, because of the need to maintain safety near wet environments and cleanliness, need to charge without using metal contacts. These products charge by inductive current through the plastic appliance housing and should be exempt from regulations as the technology does not exist to make them efficient because of the larger air gaps and plastic housings that separate the charger and the unit.

Response: The battery charging efficiency of these products can be appropriately measured using this test procedure. Whether they should be exempted from policy, treated specially, or treated the same is a question to be considered when a policy is being written. Measuring the various inductively charged products with this test procedure will indicate whether some approaches to inductive charging are more efficient than others. An exemption from the test procedure is not appropriate. No change.

104a. Many appliance battery chargers operate at less than 2 watts of output power. We suggest that Ecos and CEC exempt these low wattage appliances from the test procedure and regulations. Unfortunately, as the wattage becomes smaller, the amount of power consumed by rectification circuits (changing AC to DC) make up a large percentage of the overall power, but cannot be reduced significantly. In addition, the so-called "switch mode" type chargers are not available for many of these low wattage products. The opportunity for savings is not present and these products should be exempt. This should be stated in the test procedure.

104b. Many of the appliance battery chargers operate at less than 2 watts of output power. We suggest that Ecos and CEC exempt these low wattage appliances from the test procedure and regulations. Unfortunately, as the wattage becomes smaller, the amount of power consumed by rectification circuits (changing AC to DC) make up a large percentage of the overall power, but cannot be reduced significantly. The opportunity for savings is insignificant, which is why these products should be exempt.

Response: We do not agree that there is no opportunity for energy savings. Highly efficient power supplies are available across a very wide output power range, including 1-2 watts. Whether low-power products should receive special consideration in a policy is a question to be addressed when the policy is being written. These products can be appropriately measured by the test procedure and should not be exempted from it. No change.

105. Draft 2 of the test procedure lumps single phase, 2000 W or less motive power chargers in the same standard that includes chargers for power tools, cell phones, AAA chargers etc. I don't believe it should. The motive power battery charger industry today has well established BCI standards for measuring charger efficiency. To add additional standards and requirements to an industry that is already energy conscious is just an additional burden that is not necessary.

Response: This test procedure is suitable for measuring the efficiency of motive power battery charger systems. The fact that it is also suitable for the other types of systems listed does not limit its applicability to motive power chargers. Whether or not additional standards and requirements will be imposed depends on whether or not the jurisdictions determine that there are significant energy savings possible. No change.

Comments on Test Methodology

106. The test procedure should have no "optional" steps or any "follow manufacturer's recommendations." A manufacture could specify known conditions to have their product pass the test, creating a loophole.

> Response: The optional steps were inserted, not to make it easier for manufacturers to PASS the tests, but to ensure that it is possible to DO the tests. All optional procedural steps in the protocol were carefully selected to ensure that they had little or no effect on efficiency measurements. Many of the "options" have been removed. See changes in Section V through VII.

107. The proposed Ecos test method is not harmonized with similar test procedures that currently exist for appliance battery chargers: the U.S. Department of Energy Test Procedure, the EPA Energy Star Test Procedure or the proposed CSA Canadian Test Procedure. These procedures are all harmonized in their measurement and approach and are different in their approach to energy calculations from the proposed Ecos test procedure.

> Response: We concur that this test procedure is different than the ones listed. The listed test procedures measure only energy consumed in the battery maintenance and standby modes of the battery charger. This procedure is specifically intended to address that shortcoming and to measure energy consumed in all modes, especially the active charging mode. As such, it provides more complete information on energy consumption than previous test procedures. The organizations cited by the commenter are evaluating whether to address the active charging mode through the use of this test procedure. No changes.

108. We are concerned that there is a predisposition expressed throughout the development of the test procedure for a narrow range of technology. The presentation by Haresh Kamath at the Web Seminar Workshop underscored this by presenting only one technical solution of meeting the proposed energy efficiency targets. Instead we believe a test procedure should be neutral of the technology and allow the calculation of the total energy opportunity used, rather than become design proscriptive.

> Response: We agree that the test procedure should be technology-neutral and believe that it is. It simply provides the procedure to measure the energy efficiency or energy consumption of a battery charger system, regardless of the technology that system employs. The test procedure measures the efficiency; it does not propose policy or require particular design modifications. Various presentations and articles authored by Ecos Consulting and EPRI have highlighted multiple options for improving battery charger system efficiency. No changes.

109. [Our organization] has stated its opposition to the inclusion of "active (or charging) mode" measurement in the past, not on philosophical grounds but on practical ones. We recognize that any meaningful procedure that attempts to address "active" charging mode would need to consider multiple test cycles to represent the variety of patterns of use associated with different appliances.

Response: We disagree. Energy consumption can be measured in each operating mode with relatively simple testing. Reducing the energy consumption in each mode will reduce total energy consumption, regardless of the pattern of use. Policymakers may choose to apply different weights to the energy consumption measured in each mode to reflect the time spent by a product in each mode. Alternately, they may choose some other form of policy; that is their decision. No changes.

110. Ecos and CEC seem to prefer a test procedure and regulation that includes active charging mode energy for appliance battery chargers. To address this intent, [our organization] is developing and will shortly present a proposed test method for discussion that will include all modes (including active charging mode) of use. [Our] proposal will allow for accurate measurement of the real energy opportunity of a battery charger so that real savings to the public can be demonstrated. We believe this is the aim of PG&E in its proposal to the CEC for regulation of these products. We would like to work with PG&E and CEC on a better way to approach this.

Response: Throughout the four years and three stakeholder workshops associated with this test procedure's development, various stakeholders have expressed a variety of opinions about how to accurately and fairly measure charge mode energy consumption. After weighing all of the comments received, we completed the test procedure in September 2007 and published the final version. No changes needed.

111. We will use one example of why a better approach is necessary. The Ecos Draft #3 method of evaluating the energy in charging, stand-by and maintenance modes could be approached in a better method. By using the 24 hour energy measurement time, as proposed in the Draft #3 Ecos method, 66% of the energy derived would be in charging mode, when in fact, in the real world, well over 70% of the time is spent in maintenance mode. The Ecos Draft #3 test procedure would have the manufacturers redesign their chargers to reduce energy in the very mode that would have the least effect the reduce real energy for the citizens.

Response: We agree that reducing energy consumption in maintenance mode is important. In this regard, we believe the commenter has misunderstood the intent of the test procedure. The test procedure does not convey value judgments about one mode of operation being more important than others; it simply measures all modes of operation and reports the resulting data. Policymakers can evaluate the findings and weight the various modes differently if they so choose. No changes.

112. It is important not to lose sight of the unique qualities of appliance battery chargers. These devices are mostly low power output (often less than 10 watts, with many less than 3 watts), constant current devices, that are completely linked to the product they serve. It is not possible to look at the "box" on the end of the power cord with the receptacle plug blades as a power supply and separate it for testing from the appliance. In our design world, these are all part of the total battery charger system. For this reason, we believe Ecos should consider having a general part of the test procedure with basic measuring techniques, but separate sections that are devoted to the measurement of appliance battery chargers, which may be distinct from those chargers serving emergency lighting, fork lifts, or golf carts. To use one test procedure for different types of battery chargers is not appropriate.

Response: Preliminary drafts of this test procedure have been used successfully to measure the efficiency of a wide variety of battery chargers, including those intended for use with appliances. The fact that the test procedure can also measure the efficiency of other types of battery chargers does not diminish its usefulness for testing appliance battery chargers. No changes.

113. If it is going to cover everything under 2KW then there needs to be additional sections, which address the different charger types. I know that the scope of the CEC Battery Charger project may be larger than the one for EPA Energy Star program for appliance battery chargers, however I believe it is important to not lose sight of the unique qualities of appliance battery chargers. Except for our cord/cordless products all of our products are low power output less than 2 watts, constant current products that are completely linked to the device they serve. It is not possible to look at the "box" on the end of the power cord with the receptacle plug blades as a power supply and separate it for testing from the appliance. The circuit boards in the units are specifically designed to go with the charging adaptors and are all part of the total battery charging system. For this reason, Ecos should consider having a general part of the test procedure with basic measuring techniques, but separate sections that are devoted to the measurement of appliance battery chargers, which are distinct from those battery chargers serving emergency lighting, fork lifts, or golf carts. To use one test procedure for all different types of battery chargers is not appropriate.

Response: Same as comment above. Even though the battery delivers energy for different purposes, the fundamentals of the charging system are unchanged. How much energy does it take for a particular charger to charge a particular battery? What the battery energy is then used for is not relevant to measuring the efficiency of the charging process. No changes.

114. The proposed Ecos test procedure calls for measurement of active mode, stand-by mode, and maintenance mode charging. We do not believe that it is necessary to measure energy consumption of appliance battery chargers during active mode. For most types of appliance battery chargers, the active mode energy is only 17-22% of the overall energy used in a 48 hour time period. For longer periods, such as by week or month, the percentage is even smaller. The percentage of time spent in active mode is very dependent on the usage patterns and product category. For example, in a cordless vacuum cleaner, some use it for a few second to remove a few grains of sand or cereal, and others use it to clean the kitchen floor. The time spent in active mode varies widely with product type, usage patterns, type of home, presence of children or pets, whether there are one or more devices, etc. The active mode time intervals are widely varied. Measurement of this is unnecessary and would necessitate making judgments of the usage patterns and factors to equate the measurements. A part 2 of a proper test procedure for appliance battery chargers could accomplish this.

Response: The test procedure calls for measuring the power consumption of the battery charger in each operating mode. This can be done for any product type and with no assumptions about the usage patterns, so the "Part 2" is unnecessary. See additional responses above. No changes.

115. If Active mode is going to be part of the energy efficiency formula then the procedure needs to address all the product variables. In order to keep the standard simple and easy to understand, the measured modes of operation should be "stand-

by" and "maintenance". If you add "active" mode into the equation then it becomes complicated, as you need to account for all the variables such as product type, quick-charge, slow charge, battery type, and use patterns.
A test procedure that incorporates active mode must address these issues to be accurate in calculating energy efficiency.

> Response: See comment above. We agree that if a charger has separate charging modes for quick charge and slow charge, these should each be tested. They each constitute a separate operating mode. Section V.A has been altered to clarify what tests are required.

116. [We] believe that the time period for most appliance battery chargers to remain in stand-by mode (also sometimes called no-load, or battery uncoupled mode) is very small. Nevertheless, because there is concern about the "stand-by energy" of these products our industry agrees that it is proper to measure this amount of energy. However, it is extremely important to note that because there are significant differences in the amount of time that different products spend in standby mode within CEC/PIER battery charger products. For this reason, there should be a table assigned with values for the amount of time per week or per month that various products spend in stand-by mode, and apply this against any measurement to arrive at overall energy usage for regulatory purposes. If a cordless rechargeable vacuum has stand-by time of 3-4 minutes per month, it would seem unreasonable to equate this in regulations to a golf cart charger which may see hours of stand-by time each day. A part 2 of a proper test procedure for appliance battery chargers could incorporate such a table.

> Response: Patterns of use vary for all types of battery charging products operated by a particular user, and for various users operating the same type of product. Measuring their efficiency according to a standardized test procedure across all modes makes it possible to collect data that manufacturers and policymakers can use to identify energy savings opportunities. No changes.

117. We believe the outcome of the test procedure should be an energy ratio.

> Response: It is. Specifically, it is the ratio of the measured battery discharge energy divided by the 24-hour input energy. This ratio happens to be an "efficiency" and we generally call it that. But it is still a ratio of energies. No change needed.

118. [We] believe that all non-active modes of energy use (both stand-by mode and maintenance mode) should be collected and reported as a non-active power measurement for purposes of the test procedure, reporting or regulation. This approach will give manufacturers the ability to be flexible with solutions that meet their individual needs. The only important fact for consumers is the overall energy used/saved. Whether that comes in stand-by mode or maintenance mode is immaterial.

> Response: See above. No changes.

119. I do not believe the systems approach of measuring efficiency should be used for single phase, 2000 W or less motive power chargers. I believe it should be the charger kWh out/charger kWh in. Typical charger efficiencies in the motive power

industry are in the 75% to 90% range. These efficiencies are advertised or available for end users to look at and make their purchasing decisions. To now require a systems approach seems to defeat the purpose of making an otherwise easy decision based on charger efficiency. It is also very common in the motive power industry that the batteries and chargers come from different companies. It is also common that one manufacturers charger could be used with several different manufacturers batteries.

> Response: The ratio of (charger kWh out) / (charger kWh in) is indeed an appropriate quantity to consider in any battery charger design. We would consider this to be the "power conversion efficiency." (Even measuring the power conversion efficiency requires having a suitable battery to accept the charger output power.) But power conversion losses are not the only losses we are concerned about; we are also interested in losses that occur in the battery. Some battery losses are unavoidable; some can be reduced by encouraging the use of highly efficient batteries; other battery losses can be reduced by improved charger design. The systems approach is the simplest procedure which provides a measure of these losses as well as the power conversion losses. A systems approach is a more accurate representation of the total efficiency that the user will see. No changes.