ETA-NTP013

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Level III Charging Of Neighborhood Electric Vehicles

Prepared by

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1.0 Objective

This procedure identifies the proper method for the conduct of Level III charging of the main propulsion batteries installed in an electric vehicle while it is being tested during the NEV America Performance Test Program. It shall not supersede the charging protocols of the vehicle's supplier, nor is it meant to supersede those specifically addressed by SAE Test Standards, nor of any regulatory agency who may have or exercise control over the covered activities.

2.0 Purpose

The purpose of this procedure is to provide guidance on Level III charging of propulsion batteries during the time the vehicle is being subjected to the NEV America Performance Test Program. This procedure shall also be used to calculate charging efficiencies during the performance of the ETA-NTP005, "Rough Road Test," as well as other procedures which support the NEV America Vehicle Technical Specification. Different charging strategies shall not be mixed during a single test program unless the vehicle supplier details that as the normal method of charge operation for the end user.

3.0 Documentation

Documentation addressed by this procedure shall be consistent, easy to understand, easy to read, and readily reproducible. This documentation shall contain enough information to "stand alone"; that is, be self-contained to the extent that all individuals qualified to review it could be reasonably expected to reach a common conclusion, without the need to review additional documentation. Review and approval of test documentation shall be in accordance with ETA-NAC004, "Review of Test Results." Storage and retention of records during and following testing activities shall be completed as described in Procedure ETA-NAC001, "Control, Close-out and Storage of Documentation."

4.0 Initial Conditions and Prerequisites

4.1 Personnel conducting charging of vehicle batteries under this procedure shall be familiar with the requirements of this procedure, any applicable SAE Test Instructions, the Administrative Control Procedures, and certified by the Program Manager or Test Manager prior to commencing any charging activities.

4.2 All personnel conducting charging of batteries shall observe proper safety precautions at all times.

4.3 Charging of vehicle batteries shall be in accordance with the requirements of the vehicle supplier as stated in the Owner/Operators manual.

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4.4 Charging rates shall not exceed the maximum recommended by the vehicle supplier.

4.5 The only charging used during Testing will be Level III (Fast) Charging unless otherwise specifically required by the Owner's Manual.

4.6 Vehicles should not be left on the Level III charger if not actively charging. [When a Level III charge is complete, the vehicle should be removed from the charger, whether it is to be driven or not.]

4.7 Ambient temperature during charging shall be within the range of 40˚F to 120˚F (5˚C to 49˚C).

4.8 Battery temperature at the beginning of charge shall be between 59˚F and 100˚F (15˚C to 38˚C).

4.9 AC supply voltages for chargers shall be as specified by the vehicle supplier.

4.10 Charging of on-board battery systems should be accomplished at a charger current rating specified by the vehicle supplier.

4.11 All documentation required to complete the charging activities should be completed, approved and issued prior to commencing any charging activities.

4.12 Record the required data for all metrology used on Appendix B.

5.0 Charging Requirements

The NEV America Vehicle Technical Specifications require that vehicle suppliers provide a charger, which can fully recharge the main propulsion batteries from any state of discharge in less than 12 hours. The following instructions apply to the generic activity of Level III charging. They shall not replace or supersede the requirements of any specific vehicle supplier. Should a conflict arise, the requirements of the vehicle supplier shall take precedence.

For vehicles designed for Level III Charging, the NEV America Test Program may be conducted using Level III Charging. Because of the differences in the chargers and their potential effect on the batteries, if the vehicle supplier's Level III charge methodology is to be used, a separate EV America Test Program utilizing only the Level III methodology shall be conducted. This testing may be in addition to a full NEV America Test Program conducted using the vehicle supplier's Level II charge methodology and equipment.

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5.1 Level III Charging Requirements

Once it has been established that Level III charging will be employed, the following activities shall be completed.

CAUTION

All personnel from ETA and its subcontractors who will conduct charging operations shall be specifically trained in all aspects of the charger, including its automatic shutdowns and safety procedures.

NOTE

If necessary to transition from Level II charging to Level III charging, the vehicle shall receive at least five (5) full charge cycles and five (5) partial charge cycles in any order prior to the conduct of any NEV America Test Program procedures for Level III charging. If battery performance variations are noticeable at the end of this conditioning, the conditioning cycle shall be repeated prior to testing.

NOTE

During the conduct of the test program, it may be necessary to conduct leveling or equalizing charges using a Level I or Level II Charger. If this is required, then the equalizing charge shall be conducted in accordance with Section 5.2 of this procedure.

5.1.1 Verify by physical inspection that there is no damage to the battery charging system.

5.1.2 Record the specific charger type being used (SuperCharge, AeroVironment, etc.) and its nominal rating.

5.1.3 Identify and record the appropriate charging rates, including:

5.1.3.1 Initial Maximum Charging Rate (in Amperes).

5.1.3.2 Charging Rate (in Amperes) at which the charge will be terminated, if termination is not automatic.

5.1.4 Read and record the vehicle's onboard SOC indicator reading prior to commencing the charge on Appendix A.

5.1.5 If a kilowatt-hour meter or reading is available, this should also be recorded on Appendix A.

5.1.6 Ensure the charger-to-vehicle disconnect is Open.

NOTE

Monitoring and recording the charge and discharge cycles will provide a tertiary method to determine when the conditioning cycles have been

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completed. If the Level III charger is equipped with a computer data port (e.g., RS-232) and a computer with the corresponding software is available, the computer may be connected to the charger at this time. See the charger instructions for information on this.

5.1.7 Read and record the charger's initial totalizer value (Ah or kWh)

5.1.8 Connect the charging cable to the vehicle.

5.1.9 If required, start the Level III charger's independent power supply (e.g., diesel engine, etc.).

5.1.10 Close the charging station disconnect supplying the vehicle.

5.1.11 Read and record on Appendix A the time that charging is starting.

5.1.12 Read and record the initial DC charging current and voltage.

5.1.13 Verify the totalizer meter or the data logger is operating.

5.1.14 When the charge has completed (or the charge rate has decreased to the level determined in Step 5.1.3.2), record the following information as appropriate:

5.1.14.1 Time

5.1.14.2 Final voltage (if available)

5.1.14.3 Final charging current (if available)

5.1.14.4 Charging station location energy meter reading

5.1.14.5 Vehicle SOC reading

5.1.14.6 Vehicle Kilowatt-hour reading (if equipped)

5.1.14.7 Totalizer meter or data logger information

5.1.14.8 Vehicle odometer reading

5.1.15 If so equipped, open the charging station disconnect supplying the vehicle.

5.1.16 Disconnect the charging cable from the vehicle.

5.2 Use of Equalizing/Leveling Charges

Level III Charging provides a way to return large amounts of energy to the propulsion batteries in a short period of time. However, the battery may still require periodic equalizing charges. The vehicle supplier is responsible for determining the frequency of equalizing the propulsion batteries.

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To ensure that equalizing is done within the period specified by the vehicle supplier, equalizing charges shall be conducted by NEV America at the intervals required by the vehicle supplier.

5.2.1 If the vehicle supplier requires that an equalizing charge be conducted every X charge, when X charge is due, an equalizing charge shall be completed. If this is scheduled to occur between a days scheduled drive segments, the equalizing charge shall be considered as part of the day's normal charging regime, and shall supercede the requirements for additional drive segments until the equalizing charge has been completed. Any wait time subsequent to the equalizing charge required to occur prior to driving shall be observed.

5.2.2 If the vehicle supplier requires that an equalizing charge be completed no more often than X charges, then the equalizing charge shall be completed the night before the day in which the equalizing charge cycle would fall. [Example: if an equalizing charge is required to be completed at least every 10 cycles, and less than 10 cycles were completed during the day's drive-charge activities, the equalizing charge would be conducted at the end of that day's testing, and prior to the beginning of the next day's drive-charge activities.]

5.2.3 If the vehicle supplier requires that an equalizing charge be completed after at least N fast charges had occurred but before N+X fast charges had occurred, then the equalizing charge shall be completed the night before the day that N+X charges would be expected to occur. [Example: if an equalizing charge is required to be completed after 10 cycles but before 16 cycles, and more than 10 cycles were completed during the day's drive-charge activities, and it was expected to exceed 15 charge cycles the following day, the equalizing charge would be conducted at the end of that day's testing, and prior to the beginning of the next day's drive-charge activities.]

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6.0 Glossary

6.1 Charging Algorithm - The circuitry/mathematical controls used by a charger to automatically control the charging profile of current versus voltage versus time during the battery charge.

6.2 Charging Station Location - As used in this procedure, refers to the specific plug-in location assigned to each specific vehicle.

6.3 Effective Date - The date, after which the procedure has been reviewed and approved, a procedure can be utilized in the field for official testing.

6.4 Fast Charge - Charging conducted using a Level III Charger.

6.5 Level III Charger - A charger capable of returning 40% SOC to a battery in less than 20 minutes.

6.6 Program Manager - As used in this procedure, the individual responsible for oversight of the NEV America Performance Test Program. [Subcontract organizations may have similarly titled individuals, but they are not addressed by this procedure.]

6.7 Shall - Items which require adherence without deviation. Shall statements identify binding requirements. A go, no-go criterion.

6.8 Should - Items which require adherence if at all possible. Should statements identify preferred conditions.

6.9 State of Charge (SOC) - For this testing, the SOC of a battery is defined as the expected residual battery capacity, expressed in amperes-hours or watt-hours or miles, as a percentage of the total available. The 100% SOC basis (available ampere-hours, kilowatt hours or miles) is determined by the actual discharge capability of the main propulsion battery when discharged to the requirements of the Constant Speed Range Test portion of procedure ETA-NTP004, "Constant Speed Range Test."

6.10 Test Director - The individual responsible for all testing activities associated with the NEV America Performance Test Program.

6.11 Test Director's Log - A daily diary kept by the Test Director, Program Manager, Test Manager or Test Engineer to document major activities and decisions that occur during the conduct of a Performance Test Evaluation Program. This log is normally a running commentary, utilizing timed and dated entries to document the day's activities. This log is edited to develop the Daily Test Log published with the final report for each vehicle.

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6.0 Glossary (continued)

6.12 Test Engineer - The individual(s) assigned responsibility for the conduct of any given test. [Each contractor/subcontractor should have at least one individual filling this position. If so, they shall be responsible for adhering to the requirements of this procedure.]

6.11 Test Manager - The individual responsible for the implementation of the test program for any given vehicle(s) being evaluated to the requirements of the NEV America Performance Test Program. [Subcontract organizations may have similarly titled individuals, but they are not addressed by this procedure.]

7.0 References

7.1 NEV America Vehicle Specification

7.2 ETA-NAC001 - Control, Close-out and Storage of Documentation."

7.3 ETA-NAC002 - Control of Test Conduct."

7.4 ETA-NAC004 - Review of Test Results"

7.5 ETA-NAC005 - Certification and Training of Personnel Utilizing ETA Procedures."

7.6 ETA-NAC006 - Receipt Inspection

7.7 ETA-NAC007 - Control of Measurement and Test Equipment

7.8 ETA-NQP001 - Quality Program

7.9 ETA-NTP002 - Electric Vehicle Acceleration, Gradeability and Maximum Speed Test

7.10 ETA-NTP004 - Constant Speed Range Test

7.12 ETA-NTP005 - Rough Road Course Test

7.13 ETA-NTP006 - Braking Test

7.14 ETA-NTP007 - Road Course Handling Test

7.15 ETA-NTP010 - Measurement and Evaluation of Electric Vehicle Battery Charger Performance

7.16 ETA-NTP011 - Vehicle Verification

7.17 ETA-TP014 - Electric Vehicle Range Testing Using Level III Charging

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APPENDIX-A
BATTERY CHARGING LOG
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Charging Station No.	Vehicle:	VIN:

DATE	TIME	Connect/ Disconnect	Onboard SOC Indicator Status	Vehicle Odometer Reading	Battery Temp (°F)	kWh Meter Reading	Comments	Initials

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APPENDIX-B
Vehicle Metrology Setup Sheet
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VIN: _____

Instrument/Device:	Calibration Due Date:	Initials / Date:

Comments (initials/date):

Completed By:

(Printed Name) (Signature) (Date)

Reviewed By (QA):

(Printed Name) (Signature) (Date)

Approved By:

(Printed Name) (Signature) (Date)

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