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Title: SAFT NiCd Battery Watering		Procedure No.: CSD-760
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I Purpose:

To water the NiCd batteries in Solectria Force vehicles as periodically required by the battery manufacturer.

II Scope:

For SAFT NiCd STM100 batteries with BC3300 NLG412B SAFT charger.

III Procedure:

INTRODUCTION: Nickel Cadmium batteries use a water-based electrolyte solution. Over the course of the charging cycles, this water decomposes into hydrogen and oxygen gasses which escape through the vents in the battery. In order for the batteries to function properly, the water (distilled) in the batteries must be replenished. If the water level is allowed to get too low, the battery capacity is reduced and the batteries may be permanently damaged.

The total times required for this procedure is one hour of work time and five hours of special overcharging beyond the normal charge. This special overcharge requires five hours, but the charger keeps the batteries in this special overcharged state for up to 72 hours, meaning that once the special charged state has been reached, the actual watering step can be performed at any time over these 72 hours as convenience allows.

During this procedure, water will overflow from the batteries into buckets placed underneath the vehicle. This liquid is primarily the excess distilled water which contains a very small proportion of battery electrolyte. This is not acid, but rather base. This water can be disposed of in the sink.

WHEN: The driver of the vehicle will be alerted as follows. In the driver console / dash, just left of the steering column is a green LED light labeled "water battery". This same green LED signal can also be found on the LED box attached to the charger, in the trunk. When this LED comes on, the batteries

must be watered within 600 Amp-hours of normal charging, or the charger will automatically shut down. This provides a window of 400- 500 miles of driving, but the watering procedure should really be done as soon as possible.

The charger is programmed according to battery manufacturer specifications.These require that for every full charge cycle, the charger put in 13% extra charge (overcharge) into the batteries. The reason for this is that this battery type experiences self discharge losses of approximately that much, which are not accounted for by the Ah counter in the dash. Furthermore, the specifications require that the battery electrolyte be topped off with water every 640 Ah of this overcharge., which means corresponds to 4925 Ah of normal charging. A very efficient driver, under ideal conditions can drive 1 mile per amp-hour. Realistically 1.5 Ah per mile is to be expected. This translates to a watering interval of approximately 4000 miles (6500 km) of driving for the average driver. If this procedure is not successfully completed before this point, the charger will automatically stop charging.

The Green LED "Water Batteries" is designed to amply warn the driver before this happens. This Green LED is programmed to turn on when the overcharge counter reaches 540 Ah, which is 4150 Ah of normal charging. This corresponds to approximatly 3500 miles (5800 km) and allows the driver 400- 500 miles of driving before the charger stops charging.

TOOLS AND MATERIALS NEEDED::

- Two gallons of distilled, ion- and electrolyte-free water in the supplied container (do not use spring or tap water). Distilled water is commonly available at grocery stores.
- Command connector that came in the glove box of the vehicle labeled "maintenance charge".
- Command connector that came in the glove box of the vehicle labeled "watering confirmation" .
- Low profile bucket for collecting the overflow water underneath the vehicle.
- Optional: laptop computer and *nlg.mon* software, set up to communicate with charger.

Note: If container and connectors did not come with vehicle, or for information on computer software for communicating with charger, contact Solectria Customer Service.

PROCEDURE:

1. **If anything seems unusual, contact Solectria Customer Service right away.**
2. If using the laptop and *nlg.mon* to communicate with charger, record charge screens throughout this procedure. If not using a laptop, **just follow directions closely** and take notes.
3. **Turn ignition key to *off*** position and leave in *off* position during entire procedure.
4. **Find the special command connector** receptacle exiting from the charger. The charger is located on the driver's side of the trunk . The connector is a white three-pin connector at the end of a wire harness, fastened to the trunk carpet near the tail light. (Note: it will mate with the two Command Connectors.)
5. **Plug in "Maintenance Charge" connector** to this special white connecter**.**
6. **Plug in vehicle.** Note the LED box in the trunk near the charger. (See last page of instructions for LED box diagram and legend.) Upon plugging in the vehicle, the Green LED should go off and the Red1 and Red2 LEDs should come on. First the normal charge will be performed to bring the Ah counter in the dash back to zero. Then, a five-hour special overcharge sequence called a *maintenance charge* will begin. This charges the batteries at 10 amps for 5 hours. **It is very important that this maintenance charge not be interupted (i.e. vehicle unplugged)!** If this happens the maintenance charge must be restarted. This can be observed with the *nlg.mon* software.
7. While the batteries are charging**, locate the fill hoses and get the water supply ready.** The first fill hose is located under the hood, at the front of the vehicle just under the hood latch rail, between the latch and the passenger-side inner fender. The fill hose is a 3/8" rubber hose with a cap. The other two hoses are on the inside wall of the trunk on the passenger side near the battery coolant resevoir, behind the carpet. In some cases the two rear hoses may be attached to one another via the cap. In front of vehicle, set water container on motor mount crossbar or on a rollcart at 10" above watering tube. This height provides correct water pressure. For the two rear water loops, place water container on a towel on the roof of vehicle or on rollcart. For the front loop, one of the low profile buckets will need to be placed under the middle of the front axle. In the rear the loops drain

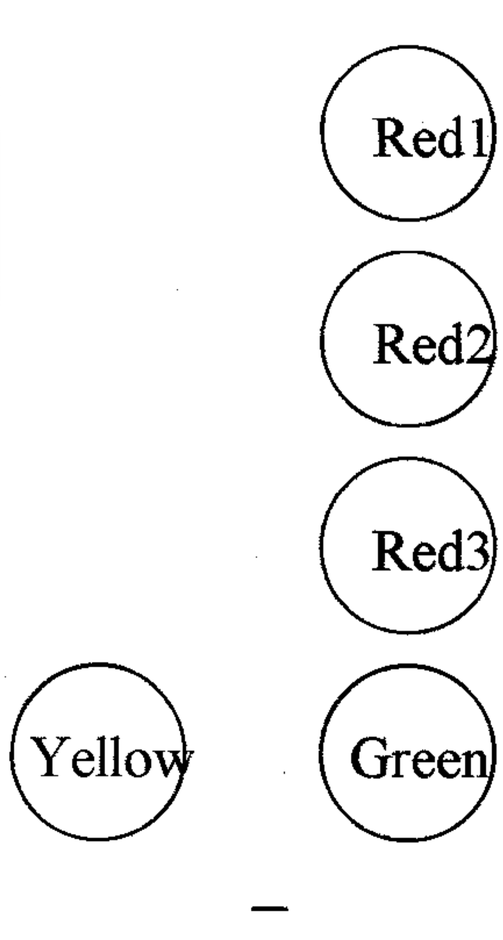
on either side below the rear bumper. This will become more apparant when the excess water begins to flow out.

8. **Wait for the proper LED sequence,** as explained below. When the batteries are done charging, the Red3 LED will come back on, so the sequence Red1, Red2 and Red3 will be lit. At this point the charger is not charging, but do not water the batteries yet. For 30 minutes the charger will remain in this state as the batteries cool down. Then, after this time, it will do a two-minute overcharge. During this the LED sequence is Red1, Red2 and Green. Next the charger returns to a resting state. During this resting state the LED sequence is Red1, Red2, Red3 and Green. For the next 72 hours the charger will alternate between 30 minutes in this state and 2 minutes in the charge state. This may seem confusing, but it will become much more apparant upon doing it. This can be observed with the *nlg.mon* software.
9. When the charger is in the rest state, with Red1, Red2, Red3 and Green**, connect "Watering Confirmation" command connector** to the same point that the "maintenance charge" was connected to. This resets the overcharge Ah counter. At this point the Green LED will go out. This can also be confirmed with *nlg.mon* by noting that the Overcharge counter on the screen has reset zero. We must confirm the watering before actually performing it for safety reasons explained in the next step. **Proceed immediately** to the next steps.
10. **Remove Watering Confirmation Plug.**
11. **Unplug vehicle.** At this point, all LEDs will go out. For safety reasons, do not water batteries while vehicle is plugged in to AC power.
12. **Water the batteries.** Try to finish this step within ½ hour. Connect the water hose from the water container to the fill hose and open the valve. Let water run until a steady stream of overflow water comes out from the overflow tube underneath the vehicle. Reposition the bucket as necessary. This should take 2-8 minutes. Be sure to replace the fill hose cap when done. It is important not to pause long between watering points, but rather to do them all so that all of the batteries are watered while at the same state of charge.

13. **Note date, mileage and quantity of water** taken by batteries used. Please contact Solectria Customer Service with this data.
14. **DONE.** Vehicle and charger will operate normally until it is time for next watering.

NOTES:

1. The batteries must be fully charged while watering. The electrolyte level drops as batteries discharge and rises as they charge . If the batteries were to be watered while at low charge, the batteries would receive too much water. This would cause water and the electrolyte in it, to spurt and overflow from the batteries during the next charge cycle. This would cause an excessive loss of battery electrolyte which would decrease battery performance.
2. LED codes on charger LED box are as follows:



None on, charger unplugged= SOC < 80% *or* charger broken

Red2 on, charger unplugged= working properly, SOC >80%

Red1, Red2 on, charger plugged in= working properly

Red1, Red2, Red3 on, charger plugged in= charge complete

Green on, at all times= need to perform this watering procedure

Red1, Red2, Green, during Maint Chg= 2 minute overcharge pulse

Red1, Red2, Red3, Green, during Maint. Chg= ready for water

Yellow on= charger fault