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Liftgate Test Results

Liftgate and 250 Watt Solar Battery Charger

2-Month Test Period: January 27-March 26, 2015

Summary Results

A major challenge for commercial trucks is maintaining adequate charge and overall health of batteries that power the truck's auxiliary systems. eNow has developed the eCharge Solar Battery Charger that e truck starter ("crank") batteries or auxiliary batteries are always topped off and ready to go. This Solar Charger is ideal for vehicles with lift gates, No-Idle HVAC, refrigeration, lighting, monitoring equipment, or other auxiliary systems that are powered by the truck's starter or auxiliary batteries.

eNow conducted a performance evaluation of a 250 Watt eCharge system charging two auxiliary batteries for liftgate power on a customer's 53 foot trailer operating in Southern California. The performance evaluation included collecting in-use test data over a two-month (eight-week) period, which shows:

- The eCharge system contributed directly to bulk charging the batteries to replace the battery energy used during liftgate operation. During the test period, the liftgate used 1,592 amp-hours and solar produced 1,508 amp-hours.
- Solar supplied up to 16 amps of charging energy during daylight hours throughout the test period, which covered the two months with historically some of the lowest solar insolation for the year.
- Minimum liftgate battery voltage never dropped below 11.2 volts, and solar helped maintain the liftgate battery charge to above 12.8 volts, an indicator of a fully charged, open circuit battery.
- Based on the data collected thus far, it appears that the auxiliary batteries were getting charged via the truck engine's alternator during lifts, meaning that the truck engine was idling during the delivery period. To realize the full potential of the solar charging system, and maximize operating cost savings, we recommend ensuring the truck's engine does not idle while making deliveries.

Problem Statement

Liftgate batteries are notorious for a short life, and sometimes running out of power during a delivery cycle and stranding the driver without liftgate capabilities. Reduced productivity costs can amount to $1,000 to $3,000 per year based on lost labor hours, product spoilage, late fees, restocking fees, and customer dissatisfaction. To avoid these costs, many commercial trucks idle their vehicles or run a diesel-powered transport refrigeration unit (if so equipped) in order to maintain battery charge. However, these approaches are costly in terms of fuel use and engine maintenance costs, not to mention noisy, polluting, and - in the case of idling - illegal in many locations.

There are many reasons why liftgate batteries lose charge over the course of a delivery cycle:

- There is insufficient engine run time to fully charge the liftgate batteries between deliveries.
- The truck engine's alternator is too small to generate enough excess power to charge liftgate batteries in a short time.
- Trucks on which liftgates are mounted are not used for several days or weeks and batteries naturally discharge.
- For trailer mounted systems, the distance charge current travels from the engine's alternator to the liftgate battery is long enough to result in a voltage drop, which lowers the charge voltage below a full state-of-charge.
- "Trail Chargers" ™ (if equipped) mounted in the liftgate battery box to boost the voltage to a level compatible with achieving a full state-of-charge, cannot fully charge the batteries due to insufficient engine runtime, low battery voltage, or failure due to corrosion or other issues.

Regardless of the reason, the resulting loss of liftgate function can have an impact on operations and bottom line.

Test and System Design

eNow worked with a lift gate partner to install a 250 Watt Solar Battery Charger to power liftgate batteries on a customer's 53 foot trailer operating in Southern California. Current and voltage data was collected between January 27th, 2015 and March 26th, 2015 using an Onset HOBO data collector. The logger measured liftgate amperage, solar amperage, and battery voltage. The data was sampled every 3 seconds and averaged into 1 minute logging entries. The trailer on which data were measured used a two pin trailer connector. It is our understanding that the trailer was used in a normal delivery cycle, which included day-time and night-time deliveries with liftgate operation. Solar energy was collected every day no matter how the trailer was used and stored in the liftgate batteries.

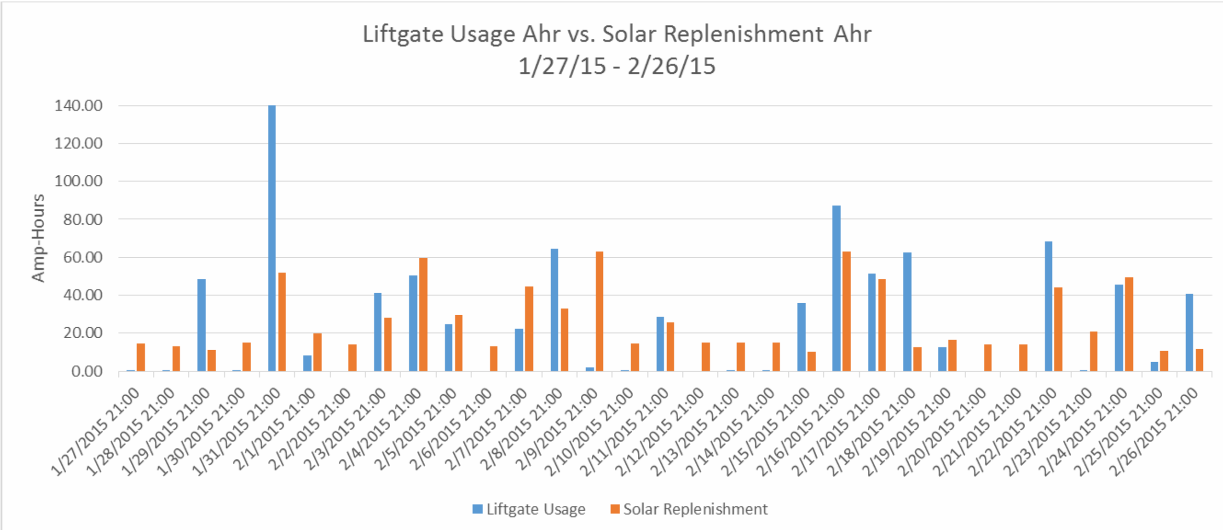
For the installation, a single 250 Watt solar panel was mounted flat on the top of the trailer near the liftgate battery system. A two-conductor cable connected the solar panel to a solar charge controller located in the liftgate battery box. The controller attached to the liftgate batteries through a very short wire harness. The solar charging did not interfere with battery charging directly from the truck engine's alternator.

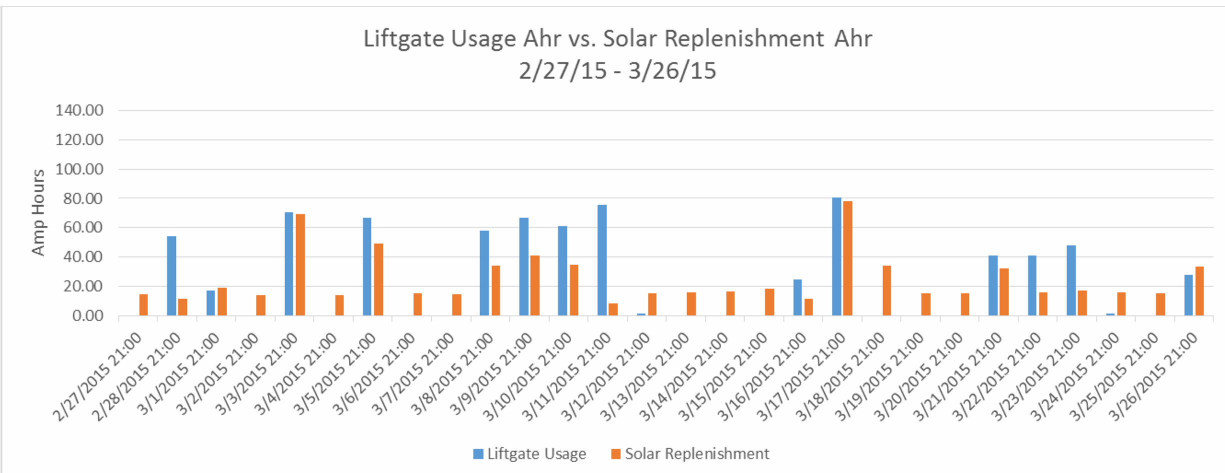
Performance Results

During the 2-month period, the trailer was active 36 days and showed little or no activity 22 days. This was determined by liftgate activity. During the test period, the liftgate used 1,592 amp-hours and solar produced 1,508 amp-hours. On days when the liftgate was not used, the eCharge system charged the auxiliary batteries to cover parasitic loads and normal battery discharge. This ensures the batteries are always topped off and prolongs the life of the batteries.

Figure 1 below shows the liftgate usage against solar production each day. As can be seen, solar production was smaller on days the liftgate was not used. This is because the auxiliary batteries were not being depleted by the liftgate, so solar was only being used to top off charge the batteries. On these days, the potential solar power available was underutilized. On days when the liftgate was used heavily, the solar responded and produced more power.

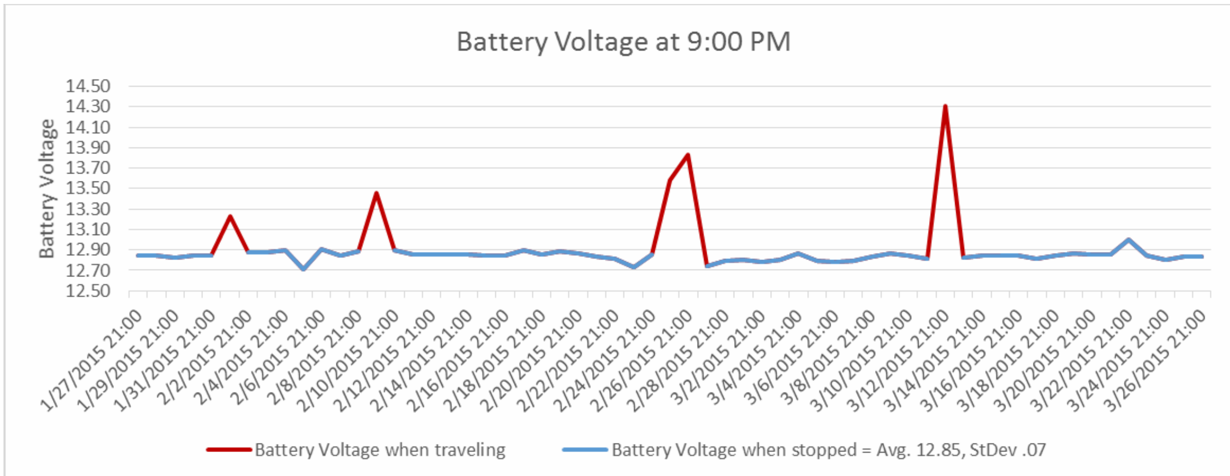
Figure 1: Liftgate and Solar Energy Each Day for February (top) and March (bottom)





One of the key measurements to determine the success of the test is to measure the battery voltage at a certain time during the day when the battery is at rest. If the voltage is around 12.8 volts at rest, it is an indication, that the batteries are fully charged. Finding a quiet period on this trailer is difficult as the trailer is often operated at night. We also need to find a time when the solar is not producing power as it will distort the voltage measurement. Figure 2 shows the battery voltage at 9:00 PM each day. Even at 9:00 PM, auxiliary battery voltage was much higher (above 13.1 volts) for four of the days, indicating the truck was in operation and the engine's alternator was charging the auxiliary batteries. When we exclude the four days the truck was in operation at 9:00 PM, the average battery voltage was 12.85 volts with a standard deviation of 0.07 volts. This would indicate a very satisfactory state-of-charge on a daily basis.

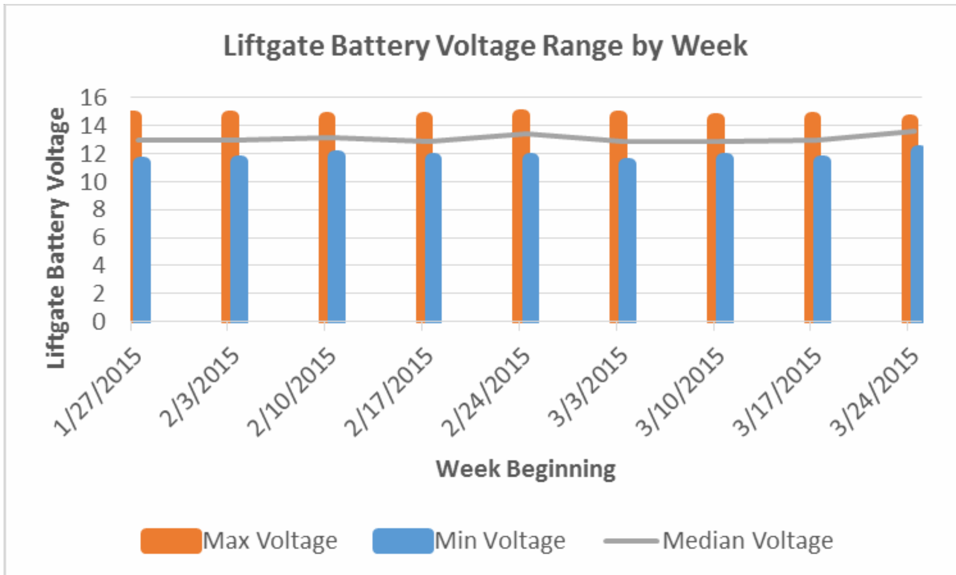
Figure 2: Auxiliary Battery Voltage Each Day at 9:00 PM



As previously pointed out, when the trailer was sitting, the batteries were only topped off, thus not utilizing all the solar potential. When we calculate the average solar production per day for Southern California (Long Beach) for the same observed period, we see that we could have produced 3,971 amp-hours instead of the 1,508 amp-hours actually utilized. This underutilization is caused by several reasons: the trailer/liftgate not being used for many days; and the trailer/liftgate being used substantially at night, thus it is only playing catch-up the next day instead of actively feeding the liftgate; and the auxiliary batteries appeared to be getting charged via the truck engine's alternator during lifts, meaning that the truck engine was idling during the delivery period.

Figure 3 shows the maximum, minimum, and median voltage of the liftgate battery each week during the test period. The minimum voltage observed was during a heavy lift and never dropped below 11.2 volts. After the lift, the voltage would rebound back into the 12 volt range. The high voltage was achieved when charging from both the eCharge system and the truck engine's alternator. The median voltage was the most common battery state, and never fell below 12.8 for any week. Based on the data collected thus far, it appears that the auxiliary batteries were getting charged via the truck engine's alternator during lifts, meaning that the truck engine was idling during the delivery period.

Figure 3: Auxiliary Battery Maximum, Minimum, and Median Voltage Each Week



Conclusions

Based on performance data collected, the issue of insufficient liftgate battery charging is being addressed with the installation of the eCharge Solar Battery Charger. The performance data shows that the eCharge system ensured the liftgate batteries were fully charged and ready for each delivery cycle. In addition, the eCharge system was shown to substantially contribute to the liftgate operation and maintaining the battery at a healthy state, which will result in a longer life of the batteries. To realize the full potential of the solar charging system, and maximize operating cost savings, we recommend ensuring the truck's engine does not idle while making deliveries. If this change is implemented, we expect to see even more impressive results during the next reporting period.