Battery Maintenance Solutions

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Application Notes on Lithium Batteries for Cargo IATA

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ABSTRACT

Changes during the last meeting of the ICAO Dangerous Goods Panel (DGP/25) addressed the safety concerns associated with the carriage of lithium batteries as cargo. It was concluded to restrict the batteries state of charge to no more than 30%. This application note will detail steps needed to reach this 30% State Of Charge (SOC) level.

Prerequisites:

- This document assumes that the user is familiar with the operation of the Cadex C7x00, C7x00-C and/or BatteryShop™ software.

A. Timed Charge/Discharge from Full or Discharged State

1.0 Fully Charged State

From a fully charged state, a custom program can be used to discharge down to the 30% level. A few things to note would be the discharge rate and the time needed to get to the 30% level. For this example, we'll look at a single cell li-ion battery at 1.0C discharge rate.

Chemistry:	Li
Cell:	1 (3.60V)
mAh:	1000
Charge:	1.0C
Discharge:	1.0C
Cap. Offset:	0%
Temp. Sensor:	5°C - 45°C
End of Discharge:	3.00V/Cell
End of Charge:	0.05C
Max. Charge:	4.20V/Cell
Max. Standby:	4.05V/Cell

Assuming this battery is fully charged, it should take 60 minutes to fully discharge the battery down to 3.0V. If we discharge for 42 minutes, this should bring the state of charge down to approximately 30%. A custom program will consist of:

Phase 1
Cycle 1, Discharge, 0h, 42m, 0s, 100 rate
Cycle 2, Skip Cycle
Skip Test
Go to Done
Go to Done

Phase 6
Cycle 1, Ready – No Charge

To calculate the discharge time with different discharge rates, use the following formula:
(1/discharge rate) x 60 minutes x 70%
An example would be a 0.5C discharge rate.
(1/0.5) x 60 x 0.70 = 84 minutes

2.0 Unknown or Discharged State

From an unknown or discharged state, a custom program can be used to charge up to the 30% level. A few things to note would be the charge rate and the time needed to get to the 30% level. For this example, we'll look at a single cell li-ion battery at 1.0C charge rate.

Chemistry:	Li
Cell:	1 (3.60V)
mAh:	1000
Charge:	1.0C
Discharge:	1.0C
Cap. Offset:	0%
Temp. Sensor:	5°C - 45°C
End of Discharge:	3.00V/Cell
End of Charge:	0.05C
Max. Charge:	4.20V/Cell
Max. Standby:	4.05V/Cell

Assuming this battery is fully discharged, it should take a little over 60 minutes to fully charge the battery. If we charge for 18 minutes, this should bring the state of charge up to approximately 30%. A custom program will consist of:

Phase 1
Cycle 1, Discharge, 0h, 0m, 0s, 100 rate
Cycle 2, Charge, 0h, 18m, 0s, 100 rate
Skip Test
Go to Done
Go to Done

Phase 6
Cycle 1, Ready – No Charge

To calculate the charge time with different charge rates, use the following formula:
(1/charge rate) x 60 minutes x 30%
An example would be a 0.5C discharge rate.
(1/0.5) x 60 x 0.30 = 36 minutes

B. Discharge Voltage Level

Another option to get the 30% SOC level would be to discharge down to a voltage level. The current C-Code structure allows the End of Discharge Voltage adjustable between 2.30V/cell to 3.20V/cell. For values greater than this, a "work around C-Code" can be used with a Discharge Only program. A NiCD C-code has an End Of Discharge voltage level adjustable from:

- 0.76V/cell
- 0.80V/cell
- 0.84V/cell
- 0.88V/cell
- 0.92V/cell
- 0.96V/cell
- 1.00V/cell
- 1.04V/cell
- 1.08V/cell
- 1.12V/cell

An example would be if a battery needs to be discharged down to 3.50V. A 4 cell NiCD C-Code can be created to discharge down to 3.68V (4 x 0.92V/cell)

For a full list of chemistries and End of Discharge values, refer to the C-Code Table found in the support section of www.cadex.com.

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