Team Neutrino Battery Testing Procedures

# Introduction

## Battery categories

Our batteries are classified into two categories, and are labeled as such with color coded tape:

* Practice/outreach: Used for practice and off-season activities
* Deep cycle: ???
* Competition: Exclusively used at competitions

Newer batteries are used for competition and older ones are used for practice and outreach.

## Connector plugs

Connector plugs are adapters for plugging in equipment such as charging cables, battery beak, etc. Prior to 2025 season, we used SB50 connector plugs (Fig xx):

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| **Fig xx.** Connector plugs currently in use: (a) SB50, (b) SB120 |

Batteries procured prior to 2024 season had 6 AWG cables connected to the battery terminals. Towards the end of the calendar year 2024, we have procured new set of batteries and we began using # 4 Flex-a-prene welding connecting cables (4 AWG) for battery terminal connections.

SB120 connectors are blue in color

SB50 are either red or pink in color

## Battery Inventory

As of February 12, 2025, we have the following batteries in commission:

* 4 AWG connectors
  + MK batteries: 6 Qty (confirm this)
  + Interstate: 5 Qty (confirm this)
* 6 AWG connectors
  + Interstate: 4 Qty (confirm this)

## Battery Names

### Grass series (2024)

| **Name (color)** | **Battery category (as of Feb 2025)** |
| --- | --- |
| Brome (black) | Practice/outreach |
| Kentucky Bluegrass (black) | Competition |
| Miscanthus (black) | Competition |
| Tall Fescue (black) | Competition |
| Zoysia (gray) | Competition |
| Little Bluestem (gray) | Competition |

### Motion series (2025)

| **Name** | **Battery category (as of Feb 2025)** |
| --- | --- |
| Crackle (gray) | Competition |
| Lock (gray) | Competition |
| Drop (gray) | Competition |
| Pop (gray) | Competition |
| Jerk (gray) | Competition |
| Snap (gray) | Competition |

### Cartoon character series (Fall 2024)

| **Name (color)** | **Battery category (as of Feb 2025)** |
| --- | --- |
| Dewey - deep cycle (black) | Practice/outreach |
| Louie - deep cycle (black) | Practice/outreach |
| Huey - deep cycle (black) | Practice/outreach |

## Charging procedures

… To add more here …

There are two methods to charge batteries:

* North-East corner of the Fluids lab (2220 Elings)
* Charging cart

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| --- | --- |
| Three charging ports in Fluids lab |  |

Fluids lab:

A general practice that the team should follow is that a plastic tab be placed at the SB120 connecting plug on a fully charged battery as shown below. We have various colored tabs and anyone can be used.

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| White plastic tab indicates that it is fully charged |

## Steps for Testing

### Preparation

* Wear eye protection
* Start with a fully charged battery
* Clean battery connecting plugs (preferably with soft cotton lint free cloth dipped in iso-propyl alcohol)
  + This step does not need to be done for every test, but periodic cleaning will remove accumulated gunk on the plugs and connectors
* Battery testing laptop is located in the North-East corner of the Fluid Power Lab on the 2nd floor of Sukup. Log in to the laptop if not already logged in
* The connectors are polarized so opposite polarities will never be in contact with the battery terminals. Care should be taken that there are no conducting materials that can connect the + and - terminals as this can short the battery

### Equipment needed

Make sure the following are available

* Hardware
  + Fully charged battery
  + Battery beak
  + Computerized Battery Analyzer (CBA V)
  + Laptop
* Apps
  + West Mountain Radio

See the figure below for a summary of the hardware and software set up for battery testing

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| --- | --- | --- |
| Fully charged battery | Battery beak 2.0 | Battery analyzer |

### 

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| --- | --- |
| West Mountain Radio app screenshot | CBA V connected to the laptop via USB, and to the battery via SB50 |

### Measurement

This is a two step process.

#### Step a. Voltages (v) and Internal Resistance (Milliohms)

* + The battery beak has a +/- terminal that is compatible with an older SB50 connector. To allow plugging the newer competition batteries, an SB120 plug to SB50 converter will be required (see fig below)
  + Plug in the battery beak to the battery’s SB50 connector and press the green button on the battery beak to turn it on. A ‘Battery Beak 2.0’ splash screen will show up

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| --- | --- | --- |
| SB120 to SB50 converter | Battery beak | Voltages and Internal resistance readings |

* + Press the green button again to measure voltages and battery internal resistance. The values V0, V2, and internal resistance (measured in Milliohms) are of interest
    - Press the green button a few times (wait a few seconds between button presses) and note down the smallest internal resistance value on a piece of paper
    - Organize the readings like the following table

| Date | Battery name | Internal resistance (milliohms) | V0 | V2 | Ah | Notes |
| --- | --- | --- | --- | --- | --- | --- |
| Feb 12, 2025 | Crackle | 17 | 13.152 | 12.836 |  |  |

* Put the Battery beak away in the designated cardboard box after done

#### Step b. Electrical Charge, measured in Ampere Hours

* Theory: An ampere hour (Ah) is a unit of electrical charge that measures the amount of current (amps) flowing over a specific period of time. We measure Ampere hours for the battery to discharge from its fully charged state to 12.0 V while keeping the current constant at 3A.
* Once connections are made and set up is complete, this process takes a few hours to complete
* Plug in the SB120-to-SB50 adapter to the battery’s SB120 plug (see fig below). This step will not be needed if the battery already has an SB50 plug
* Connect the SB50 plug into the CBA V via SB50-pigtail adapter
  + Always leave the pigtail adapter plugged into the CBA V since it is not needed elsewhere

|  |  |
| --- | --- |
| SB120 to SB50 adapter plugged into the battery | CBA V to SB50 to SB120 to Battery connection |

* Plug in the USB cable coming out of CBA V into the laptop’s USB port and open the West Mountain Radio application. If the app is already open and a battery test was previously performed, click on ‘New Test’ at the top left corner as shown below.

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| Start a New Test |

* Clicking on ‘New Test’ or if the app is opened the first time after the laptop reboot will show the following pop up screen

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| User provided information in the West Mountain Battery Test App |

* Provide a filename to save the test results. There is a suggestive file name that appears by default containing current date
  + Remove ‘Discharge\_1’ and enter the battery name so it reads something like
    - ‘250211\_Miscanthus’
  + Copy the file name field and paste it in ‘Test Name’ field
* Make sure the Cutoff Voltage is set to 12.00 V and Test Amps are set to 3.00A (both of these generally are a one time setup)
* Press ‘Start’. This will trigger a fan running in CBA V and can be audible as a hum.
* The battery will now discharge at a fixed 3A current draw until the voltage drops to 12 V. This process takes about 2 - 3 hours to complete.
* A discharge chart showing the voltage drop over time will show up on the West Mountain Radio app like below

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| Voltage drops from 13 V to 12 V (Y-axis) over time (X-axis) |

* At the end of the test, i.e., the red plot touches the green line, note the AH value indicated within the red highlighted box in the image. Fill in the measurement table like below

| Date | Battery name | Internal resistance (milliohms) | V0 | V2 | Ah | Notes |
| --- | --- | --- | --- | --- | --- | --- |
| Feb 12, 2025 | Drop | 17 | 13.152 | 12.836 | 7.146 |  |

* The plot should smoothly taper off to 12 V mark. If any abnormalities in the plot sequence are observed (something like below), jot some notes down (e.g., sudden drop observed)

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| Discharge abnormalities |

* Disconnect the battery from CBA V and charge the battery either next to the laptop or in the battery cart
* To start another battery test in the West Mountain app, click on ‘New Test’ at the top left corner and repeat the testing process for another battery