Calibration and Accuracy Report

ECE 492 - Spring 2016

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Introduction

This document serves to estimate any uncertainties which will be associated with all measurements required for ATP. It includes some analysis of measurement uncertainty as well justification for ATP test design to ensure that uncertainty can be suitably determined. This document is closely linked to from ATP to serve as the pass/fail criteria for some tests which require measurements to fall within a standard uncertainty in order to be deemed acceptable.

Throttle Percentage

Throttle percentage is analogous to the percentage voltage drop out of a known input range over a potentiometer in the Huff Dynamometer box. In order to ensure that the percentage being set is accurate to the percentage voltage drop, this voltage in the box is to be measured and the setting that was used should fall within +/- 5% of this measurement.

Relevant ATP Items

ATP Items 01 and 06 require setting the throttle to known values, so this confidence interval is relevant to those items.

Motor RPM

Motor RPM is measured in the current setup by an optical encoder, which should be very accurate and require little calibration. Nevertheless, some tests in ATP depend on this measurement to pass, so it must be ensured that the measurement is accurate. A confidence interval of +/- 5% will be defined for any measurements as compared against a strobe which can be used for testing. Additionally, readouts from the motor controller for RPM will be calibrated in the VSCADA software based on a test using the strobe reading compared to the voltage output of the optical encoder included in the current system.

Relevant ATP Items

ATP Items 01 and 06 involve measurement of motor RPM, so this confidence interval is relevant to those items.

Torque

Torque is currently measured by a load cell connected to the bar in dynamometer system. Calibration of the voltage output from this cell into the Huff box as compared to the actual torque on the bar has been performed using a test involving masses of known weight being hung off of the bar. Data from this test can be seen below:

	WinDyno-800					Torque(lb-ft)	
Weight	1 up	2 down	3 up	4 down	Vout Direct	Theoretical	VSCADA
0	-0.015	-0.01	-0.01	-0.01	-0.01		-0.12
4.34	0.068	0.078	0.073	0.073	0.074		2.366
9.34	0.166	0.176	0.171	0.171	0.173	7.5	5.44
14.34	0.269	0.273	0.273	0.273	0.271	15	8.368
19.34	0.366	0.371	0.371	0.371	0.372	22.5	11.3
24.34	0.469	0.479	0.474	0.474	0.471	30	14.37
29.34	0.566	0.576	0.571	0.571	0.572	37.5	17.3
34.34	0.669	0.674	0.674	0.674	0.671	45	20.23
39.34	0.771	0.771	0.771	0.771	0.77	52.5	23.3
44.34	0.869	0.869	0.869	0.869	0.869	60	26.23
49.34	0.967	0.967	0.967	0.967	0.969	67.5	29.06
54.34	1.064	1.064	1.064	1.064	1.067	75	32.23

The calibration factor determined for this data will be incorporated into the VSCADA software for purposes of data logging, and therefore measurements for the purposes of ATP items should be accurate. To ensure that tests pass, measured values of torque should be within a +/- 5% interval as compared to the torque calculation from the raw voltage value read out of the load cell.

Relevant ATP Items

ATP Items 01 and 06 involve measurement of torque, so this confidence interval is relevant to those items.

Power Delivered to the Load (including current and voltage)

The power which has been delivered to the load can be calculated by multiplying the above-mentioned torque and RPM values, but it is also important to know the power supply current and voltage values for several purposes; one notable calculation which is made in ATP item 03 is system efficiency by comparing these two power calculations. It has been determined that the current and voltage readouts from the power supply can be accepted as accurate, so determining the accuracy of measurements elsewhere in our system is trivial. As long as the measurements fall within a +/- 5% confidence interval of the measurements readouts, then the measurements are acceptable.

Relevant ATP Items

ATP Items 01, 03, and 06 involve measurements of current and voltage supplied to the load, so this confidence interval is relevant to those items.

Cell, Pack, and total TSV Voltages

Voltage measurement points will be included on the fully integrated accumulator for each of the voltage measurements listed, so a simple multimeter reading can be used as comparison for determining accuracy of the readout from the PackMan software. Once again, a confidence interval of +/- 5% will be used to determine if the output on PackMan and VSCADA is accurate and therefore acceptable.

Relevant ATP Items

ATP Items 01 and 02 involve measurement of cell, pack, and TSV voltages, so this confidence interval is relevant to those items.

Tractive System DC Current and Motor Phase Currents

DC Current from the accumulator will be measured using a current sensor which will be embedded inside the pack. This sensor has been deemed accurate for use in comparison purposes.

Relevant ATP Items

ATP Items 01, 03, and 06 involve measurement of these currents, so this confidence interval is relevant to those items.

Rate of Charge/Discharge and SOC of Accumulator

State of charge will be determined by integration of the tractive system DC current listed above, so its accuracy is linked with the accuracy of the current measurement.

Relevant ATP Items

ATP Items 01 and 05 involve measurement of ROC and SOC, so this confidence interval is relevant to those items.

Temperatures of cells and other subsystems

For purposes of calibration and determining the accuracy of our temperature measurement, a thermocouple meter will be used as the standard measurement.

Relevant ATP Items

ATP Items 01, 03, and 05 involve measurements of voltage, so this confidence interval is relevant to those items.

Coolant flow rate

Relevant ATP Items

ATP Item 01 involves measurement of coolant flow rate, so this confidence interval is relevant to that item.