Allen, Bill and Dave, September 6, 2011

We are communicating to you lab results for the NCAR PCASP (SN=23738-0491-08). In this report we summarize flow and sizing calibrations obtained before and after the ICE-T project (Sections 1 and 2). In Section 3 we comment about the large transit times we observe when testing the probe with D>0.2 µm particles and the status of the needle heater.

1) Flow Calibration -

We recommend the following sample flow calibration.

Standard cubic centimeter per second = 7.51885 + (-8.46821e-3)*COUNTS + 2.30130e-6*COUNTS^2

This is based on a fit of flow rate (measured with a bubble flow meter) versus signal from the PCASP's sample flow meter. The former corresponds to a volumetric flow rate converted to its equivalent standard flow rate. The latter is expressed as an integer representation of the signal from the PCASP's sample flow meter obtained as

COUNTS = V_{out} /4.8828125e-3 + 2048

Here V_{out} is the analog signal from the PCASP's sample flow mass flow meter measured at pin #16 on the SPP-200 backplane. As shown in Figure 1, the flow calibration we are recommending was obtained by fitting both the pre-project and post-project data.

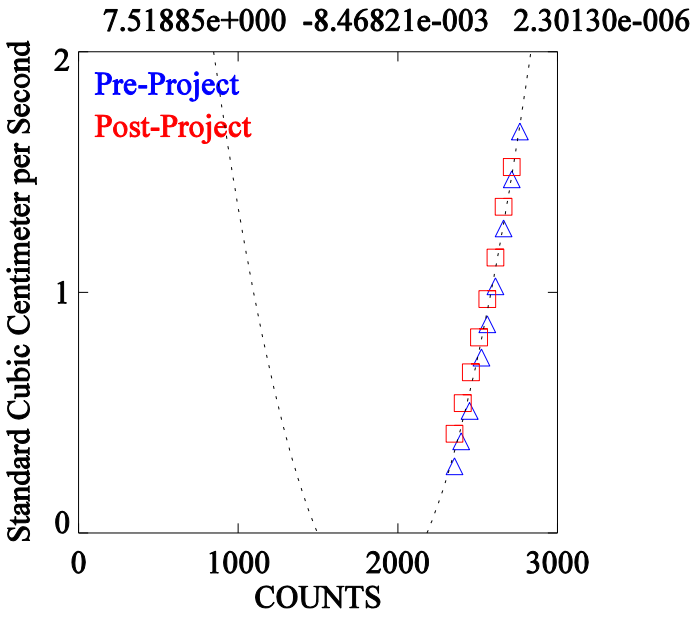
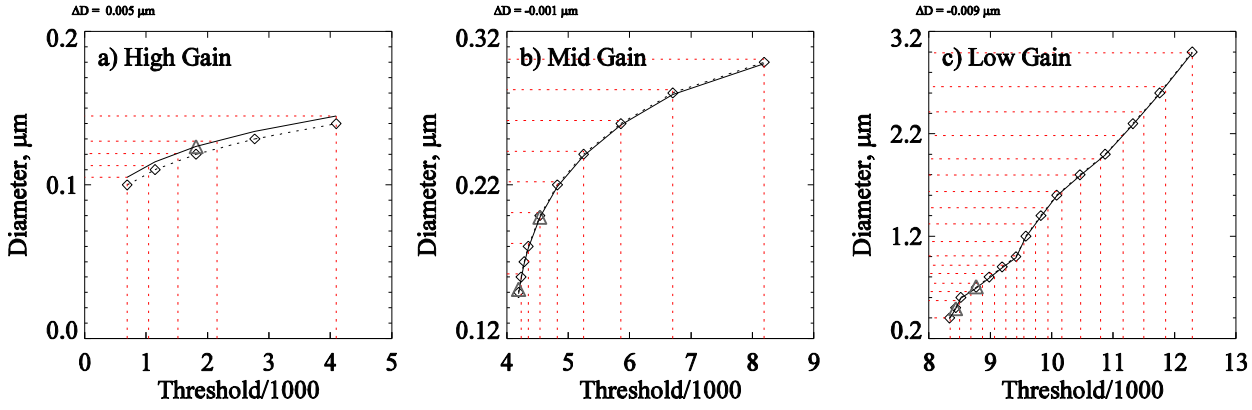


Figure 1 – Flow calibration data and a fit to a second-order polynomial.

2) Size Calibration -

For the size calibrations, pre- and post-project, results were the same for the 0.199 µm and 0.707 µm polystyrene latex (PSL) particles. The absence of a size calibration shift is encouraging. For the three other sizes we tested (0.125, 0.152 and 0.491 µm) there was a one-channel shift, all in the same direction, between the pre- and post-project testing.

Figure 2 has the PCASP sizing we are recommending for the refractive index 1.59 PSL particles. Because the post-project calibration exhibits better consistency among data derived using the five PSL sizes, our recommendation is based on the post-project size calibrations. How we arrive at that recommendation requires an explanation. First, recall that the NCAR channel thresholds are non-conventional. Second, when the NCAR is in our lab we load the factory threshold table. Third, the factory threshold–diameter relation is indicated (Figure 2) by diamonds connected by the dashed black line. Fourth, the gray triangles show our laboratory measurements. Fifth, the solid black line is the threshold/diameter calibration we derived using the post-project testing done with the five PSL sizes. Finally, the recommended threshold/diameter relation was obtained by projecting the NCAR thresholds onto the solid black line. We estimate the lower-limit diameter, for the first channel, to be 0.097 µm.



692	0.105
1040	0.113
1517	0.121
2157	0.129
4096	0.145

4231	0.162
4348	0.182
4537	0.202
4825	0.222
5251	0.242
5859	0.262
6703	0.282
8192	0.302

8345	0.401
8502	0.570
8682	0.656
8872	0.740
9070	0.833
9252	0.917
9432	1.008
9544	1.148
9737	1.319
9937	1.479
10166	1.636
10471	1.796
10797	1.955
11162	2.184
11499	2.413
11852	2.661
12288	2.991

Figure 2 – size calibration

3) Issues

1) Particle transit times reported by the NCAR PCASP are unusual. We are baffled by the large transit time (~3000 microsecond) when the probe is measuring test particles with diameter larger than 0.2 μm. Two other PCASPs do not exhibit this behavior, e.g., for those probes the transit time for D>0.2 μm is ~20 microsecond. We commented on this prior to ICE-T.

2) The needle heater resistance is infinite.

3) The probe's laser reference voltage is ~7.7 volt.

4) For the desiccant tube, we recommend that the bead-type silica gel desiccant, with an indicator, be used in lieu of the smaller grain (white) desiccant used by NCAR. With the bead-type we have less trouble with compacting, plus the bead-type we use has colored grains which indicate if the desiccant is spent.

Regards,

Jeff Snider and Yong Cai