Aerogage corporation
P.O. Box 1141, Sterling, MA 01564 Tel: (978) 422-8224 Fax: (978) 422-8225

Probe Calibration Procedure

Rev: 02
8/19/02

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Required Tools

1. Probe holder for mounting single or multi electrode sensor.
2. Sample target (e.g., turbine blade).
3. Precision mechanical stage for moving target in front of sensor electrode(s).
4. Dial indicators, as needed, to measure motion of target.
5. Precision capacitance meter, such as Aerogage CP-01 Capacitance Preamp and digital voltmeter (4½ or more digits preferred) or HP4285A Precision LCR Meter.

Procedure

1. Mount sensor in rigid holder. Use the shortest possible cable to minimize cable capacitance. If using Aerogage CP-01, refer to Operator's Manual for probe installation instructions. Attach cable to input of capacitance meter or preamp.
2. Mount target in holder on mechanical stage. Position target in front of sensor electrode.
3. Connect target to ground of capacitance meter with short wire.
4. Adjust position of target to be in front of sensing electrode and touching electrode. Record position.
5. Move target away from sensor electrode in small increments in direction corresponding to radial motion of blade. For example, use 0.001" increments for 0.000" to 0.020", then 0.002" increments for 0.020" to 0.050", then 0.005" for 0.050" to 0.100", then 0.010" increments for 0.100" to 0.200". At each position, record the capacitance of the sensor.
6. Continue to move the target until a final, asymptotic value of capacitance is obtained. This value, Co, will be used in step 10 below. Typically, the gap will be on the order of 2 to 3 times the longest dimension of the electrode.
7. Verify the capacitance as a function of gap by repeating measurements as necessary.
8. Plot the capacitance as a function of gap to verify measurements. The plot will help to show any errors in data collection.
9. Plot ln(C-Co) vs ln(X) where
   C = measured capacitance
   Co = asymptotic value of capacitance (sensor capacitance with no blade in front of sensor)
   X = gap
10. Determine the best-fit cubic equation to relate ln(C-Co) and ln(X) in the form of:
    ln(X) = a3 * y^3 + a2 * y^2 + a1 * y + a0
    where y = ln(C-Co)

Note that this is "backwards" in the sense that the curve fit is of the form x = f(y).

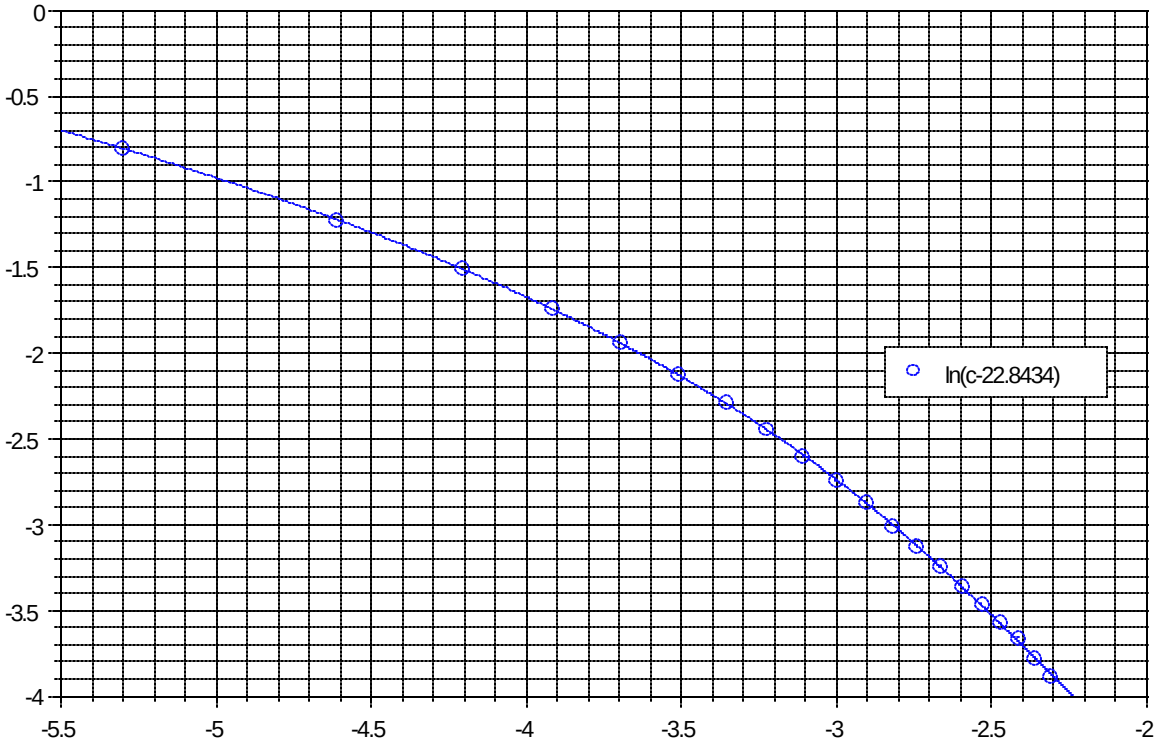
12. The coefficients a0, a1, a2 and a3 are used in the LabView programs (e.g., Disp, Log, etc.) to convert measured voltage to gap. Remember to include the sign of the coefficient in the LabView program.

Example of probe calibration: 0.100” single electrode sensor and turbine blade.

Data taken at .005” steps.

Coefficients: A3=-.04620886 A2=-.5328655
A1=-2.604253 A0=-7.083788

x	c	c-22.8434	ln(x)	ln(c-22.8434)	x est	error
0.001	24.455	1.6116	-6.90776	0.477227	0.000213	-0.00079
0.005	23.288	0.4446	-5.29832	-0.81058	0.005	-9.3E-08
0.01	23.136	0.2926	-4.60517	-1.22895	0.010029	2.85E-05
0.015	23.063	0.2196	-4.19971	-1.51595	0.015004	3.5E-06
0.02	23.018	0.1746	-3.91202	-1.74526	0.019918	-8.2E-05
0.025	22.986	0.1426	-3.68888	-1.94771	0.024935	-6.5E-05
0.03	22.9625	0.1191	-3.50656	-2.12779	0.029901	-9.9E-05
0.035	22.9439	0.1005	-3.35241	-2.2976	0.034987	-1.3E-05
0.04	22.9294	0.086	-3.21888	-2.45341	0.039974	-2.6E-05
0.045	22.9169	0.0735	-3.10109	-2.61047	0.045289	0.000289
0.05	22.9072	0.0638	-2.99573	-2.752	0.050315	0.000315
0.055	22.8996	0.0562	-2.90042	-2.87884	0.055007	6.54E-06
0.06	22.8925	0.0491	-2.81341	-3.0139	0.060199	0.000199
0.065	22.8868	0.0434	-2.73337	-3.1373	0.06513	0.00013
0.07	22.8821	0.0387	-2.65926	-3.25192	0.069883	-0.00012
0.075	22.8778	0.0344	-2.59027	-3.3697	0.074961	-3.9E-05
0.08	22.8744	0.031	-2.52573	-3.47377	0.079631	-0.00037
0.085	22.8712	0.0278	-2.4651	-3.58272	0.084733	-0.00027
0.09	22.8689	0.0255	-2.40795	-3.66908	0.088951	-0.00105
0.095	22.866	0.0226	-2.35388	-3.78981	0.09515	0.00015
0.1	22.8637	0.0203	-2.30259	-3.89713	0.101002	0.001002



.005 to .100:
f(y) = -4.620886E-2y^3 + -5.328655E-1y^2 + -2.604253E+0*y + -7.083788E+0R3^2 = 7.716866E-1,R2^2 = 8.696892E-1,R1^2 = 9.617801E-1,R0^2 = 9.999671E-1