04/01/99

Calibration of the Valydine transducer

used for pressure/velocity measurements on the Open-Throat Tunnel

Purpose

The Valydine pressure transducer needs to be calibrated against a standard (reference) instrument before to be used or after long usage time. The standard instrument used for calibration is the Rouse manometer (least scale division of mili-inches).

Procedure

- Check the tubing and the electrical connections (see Figure 1).

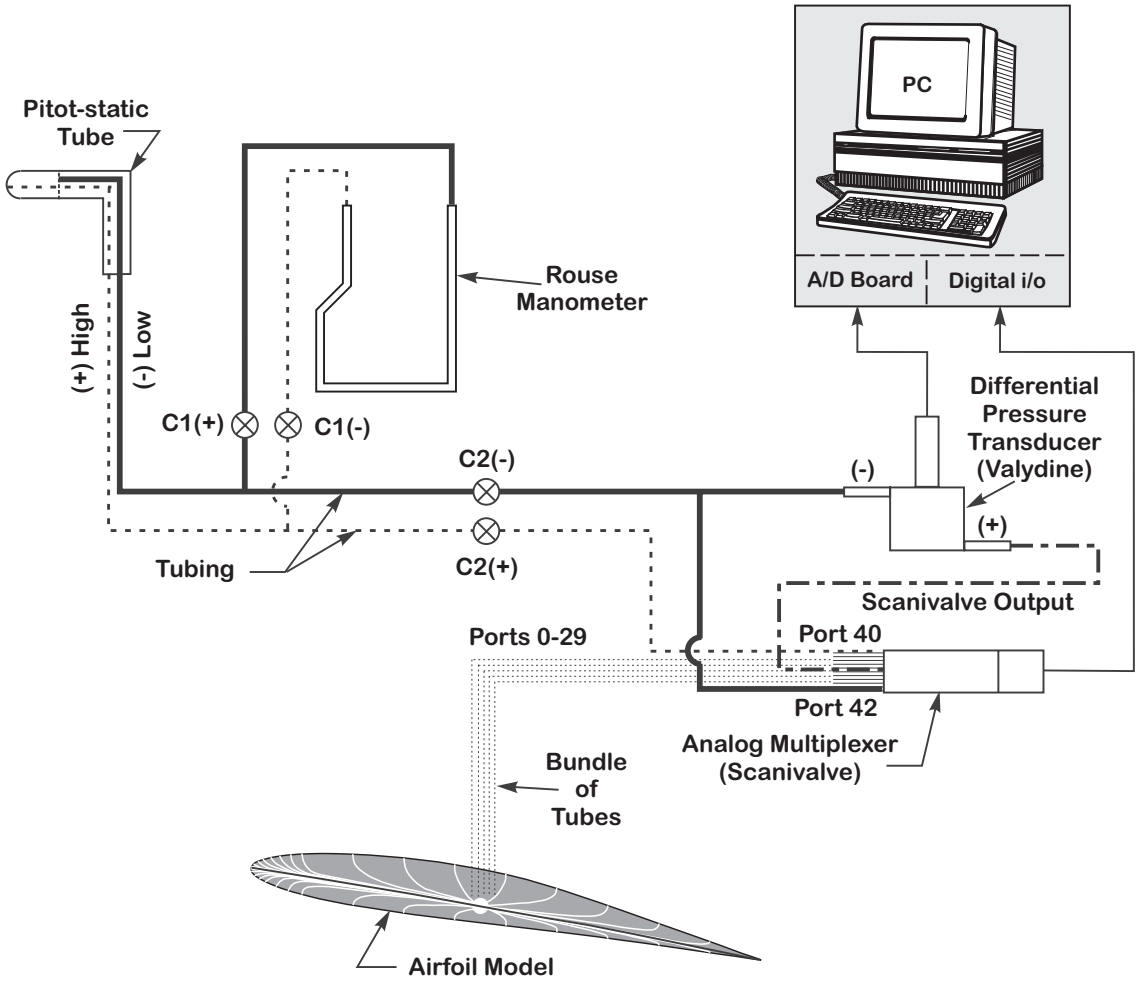


Figure 1. General configuration of the measurement system

- Turn-on the computer, the Scanivalve signal conditioner (SSC), the scanivalve controller (SC), scanivalve positioning (SPC), and the Digital Multimeter (DVM) as explained in the Airfoil experiment handout.

Zero the VSC by adjusting the **Zero** knob on the Validyne until a zero reading is achieved on the DVM. An appropriate reading for this procedure is about 10^{-3} V. Make sure that the DVM scale range setting is appropriate and is connected to the VSC.

Adjusting the Knobs on the VSC

These knobs will only operate if the lever on the knob is adjusted up. Remember to lock the knob when you are done!

- Set the SCPU in manual mode and position the controller at port 40. Port 40 corresponds to the stagnation pressure port on the free-stream Pitot-tube.
- Turn-on the wind tunnel to maximum operating speed by rotating the handwheel 19 turns to the right, and then set span to + 4.8V (instead of + 5V for safety) on the multimeter to use efficiently the entire resolution of the transducer.
  Note: after the calibration is performed be sure that the pressure differences measured with the transducer during the experiments do not exceed the range of pressures used in calibration. For example, for the Airfoil experiment set the targeted velocity in the tunnel and measure the pressure at taps 1,2, 3 and 27, 28, 29 for the airfoil set at the maximum angle of attack to be used in the experiment. The voltage on the DVM should not exceed values outside the interval –5V to +5V.
- Open on the computer the Virtual Instrument (VI): D:/lv_local_pc/IIHR.lib/IIHR.libs/RefCond.lib/tunnel velocity/temperature (see Figure 1) within this VI adjust the barometric pressure and the density of the liquid used in the Rouse manometer. Hit the "== >" sign on the menu bar. Minimize the window.

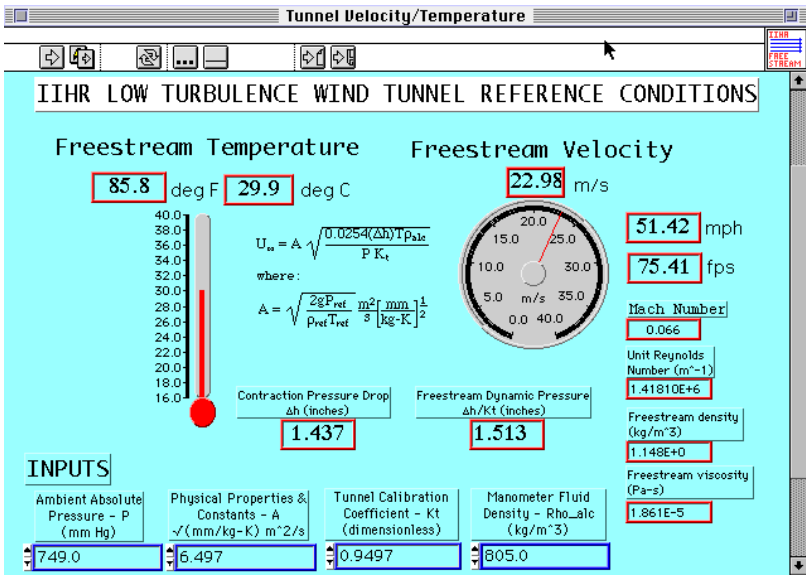


Figure 2: Tunnel Vel/Temperature VI Screen

- Open on the computer the VI: D:/lv_local_pc/IIHR.lib/IIHR.top/x-ducer.lib/Two-xducer calibration (see Figure 3).

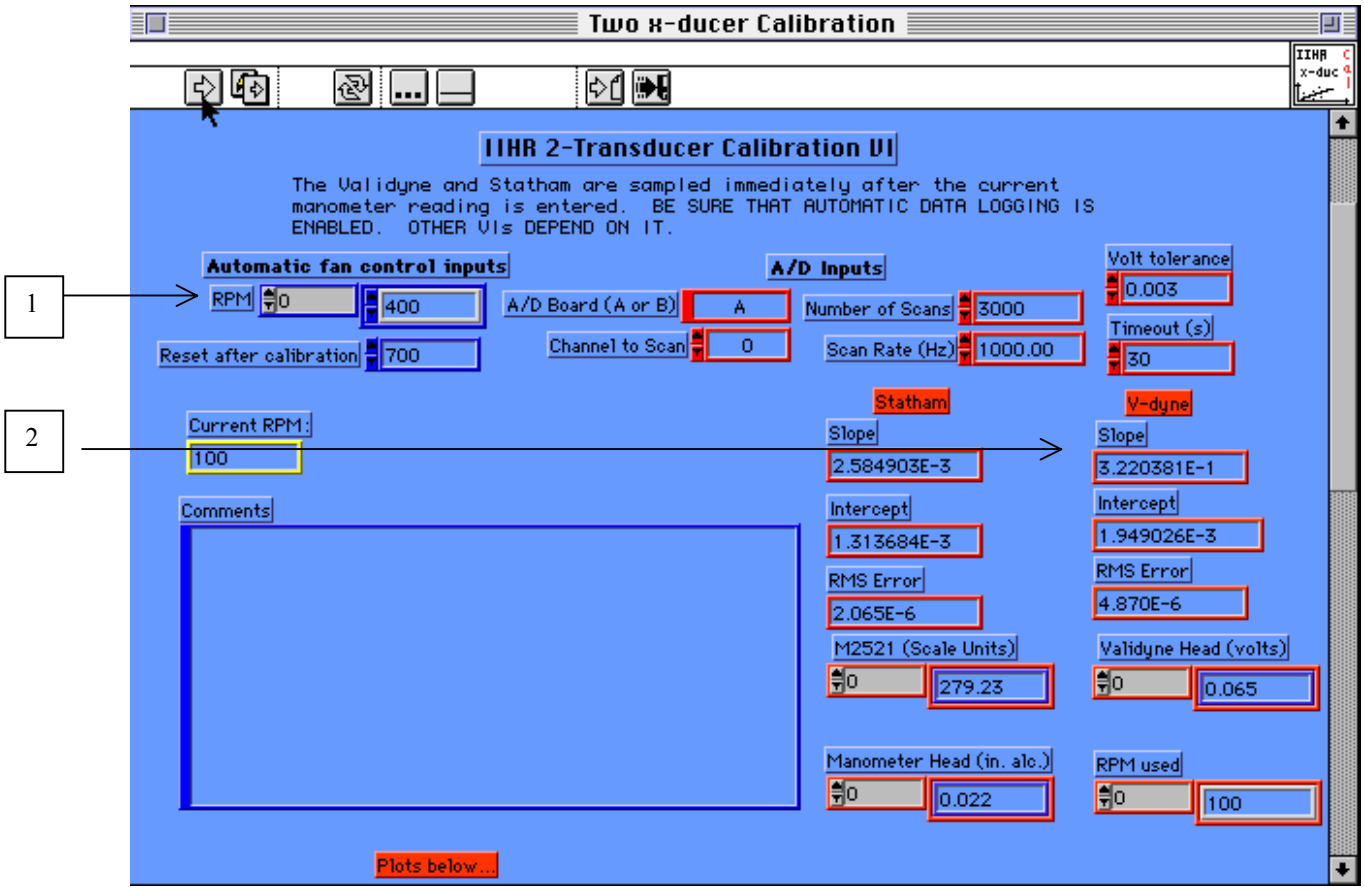


Figure 3. Two x-ducer Calibration VI Screen

is an array which determines how many calibrating points will be used during calibration.

Calibration Points

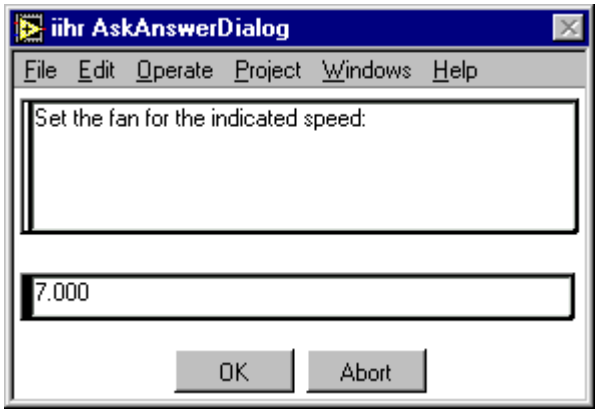
Pressure on the surface airfoil can be both positive and negative, hence the transducer needs to be calibrated accordingly. The calibration of the transducer is made using the free-stream Pitot, which will always have the same sign for the measured differential pressures. To calibrate the transducer for negative pressure switch the tubings leading to the lower and higher side of the Valydine..

The TwoX-ducer Calibration VI does not consider more than 8 points as input in . Seven values will be set by the user and the software automatically adds the origin as the eighth calibration point (hence, on the final calibration plots you will find 8 points). Consequently pre-establish seven points for the calibration to span the

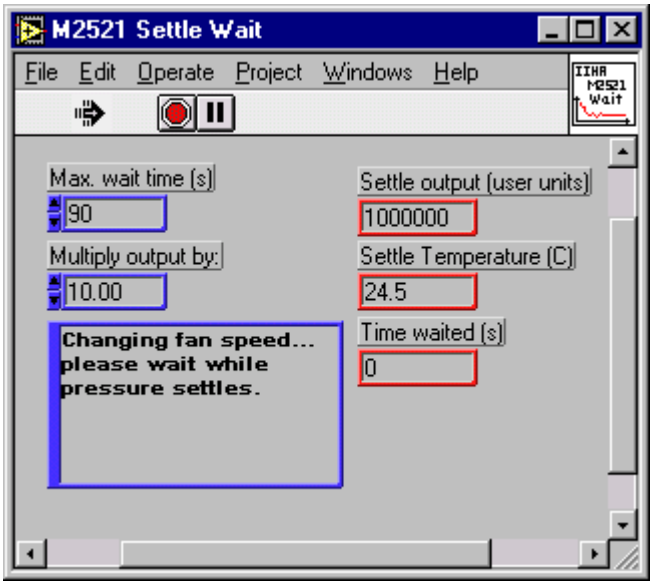
entire available voltage interval, say, 4 for the positive pressures and 3 for the negative pressures. The maximum rpm on the tunnel fan is obtained by setting 19 full rotations on the hand-wheel located to the right of the start button. Choose increments of 5 -7 full rotations of the hand-wheel to equally space the calibration points.

- Set 8 (user calibration points) in window . Hit ⇒.

A) After a few seconds a dialog box will ask for the rpm reading. Neglect this window by pressing OK.



B) Another window will appear (M2521 Settle wait) where you …just wait.



C) It's a good time to do now the readings on the Rouse manometer. Readings of the Rouse Manometer are made by following 8 steps.

- *Check that the clips on the pressure tubes connected to the manometer are open*
- *Turn the knob on the manometer to the '0' position (this is the waiting position).*

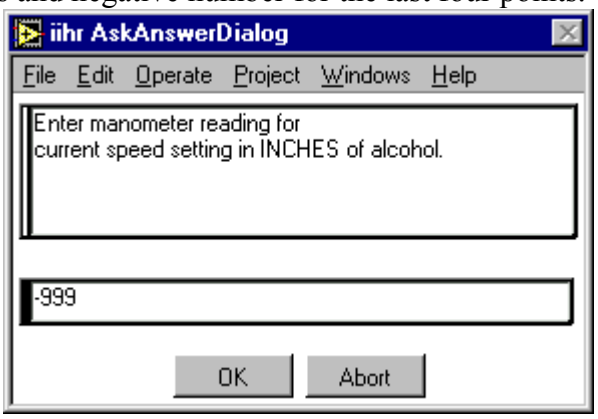
- *Zero the Rouse Manometer (Set counter to zero without using the handwheel)*
- *Turn the knob on the left hand side to '+' (a height difference between the fluid columns on the manometer should become present)*
- *Turn the handwheel until the column fluid levels become equal.*
- *Record value on the counter.*

Reading The Rouse Manometer Counter

The display on the Rouse manometer are mili-inches. That is, the value that is read from the manometer needs to be divided by 1000 to get inches of alcohol head.

- *Turn knob to the '0' position (this is the waiting position).*
- *Reverse the handwheel until the counter value becomes zero.*

D) Next another dialog box appears asking you to input a pressure in **inches** of liquid in the Rouse manometer (usually alcohol). The inputted values are positive numbers for the first four points and negative number for the last four points.



Repeat this sequence for the first 4 calibration points by appropriately selecting the rpm on the tunnel fan.

E) After the sequence A to D is repeated for the first four calibration points, reverse the leads on the Valydine transducer for measurement of the negative pressures. Continue to sequence A to D for the next four calibration points. **Note**: when calibrating for negative pressures, insert the values (inches of alcohol) with the **minus** sign.

Do Not Forget

- To return the port settings across the Validyne after the calibration is complete.
- The clips on the Rouse manometer tubing should be closed all the time, excepting when pressure measurements are made.

Evaluating the Calibration

The key values to examine on the above screens are the RMS and Intercept values for the VSC (labeled on Figure 3). These should be as small as possible. Typically RMS and Intercept values for the SSC and the VSC run between 10-4 and 1x10-3. Remember to scroll downward in the VI to access the calibration curves.

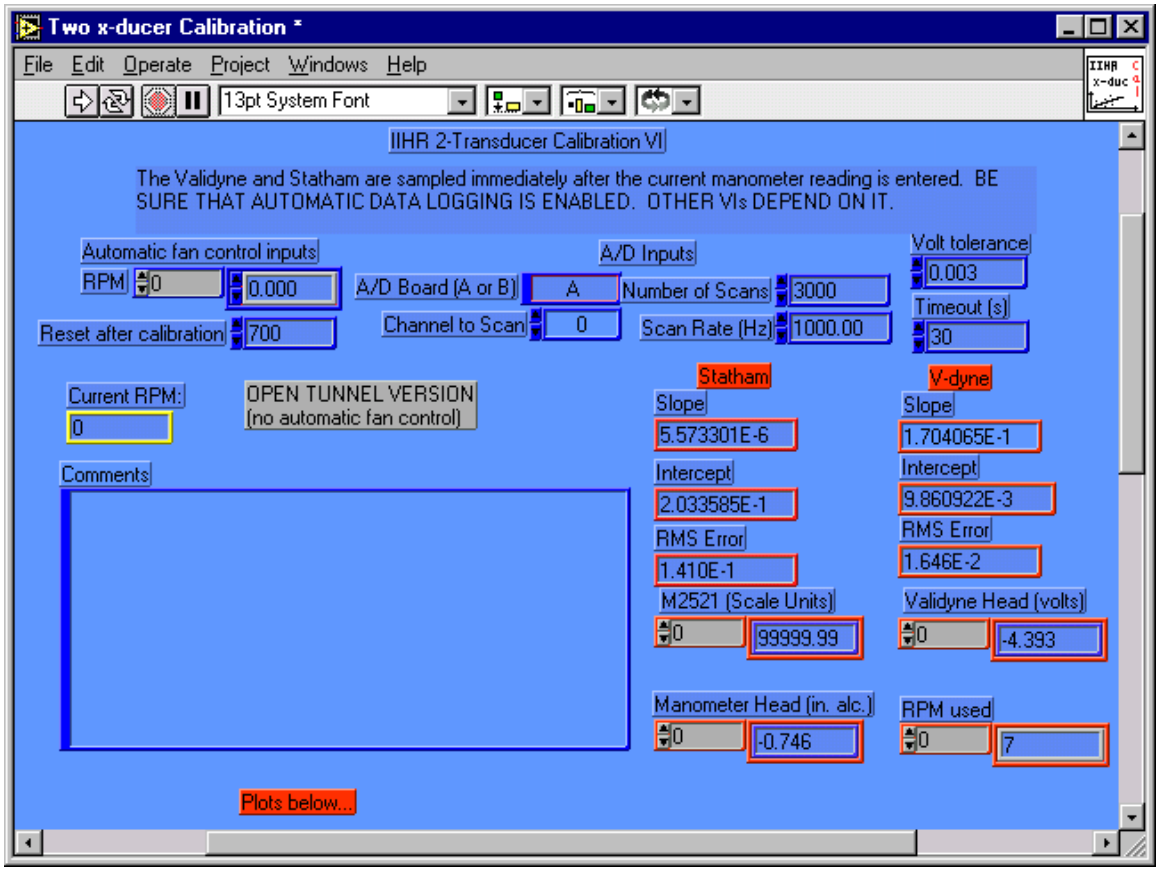


Figure 4.a : Sample of plots generated by Two x-ducer Calibration VI (top)

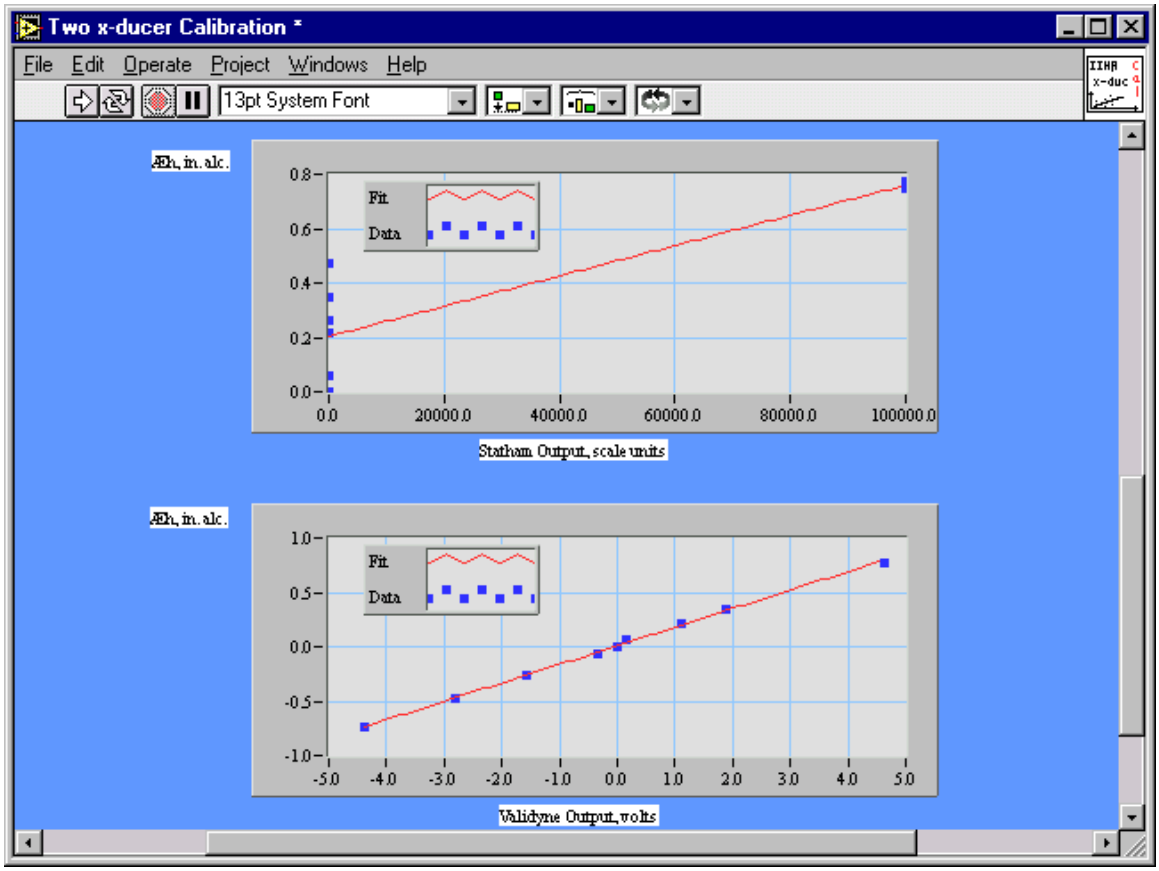


Figure 4.b : Sample of plots generated by Two x-ducer Calibration VI (bottom)