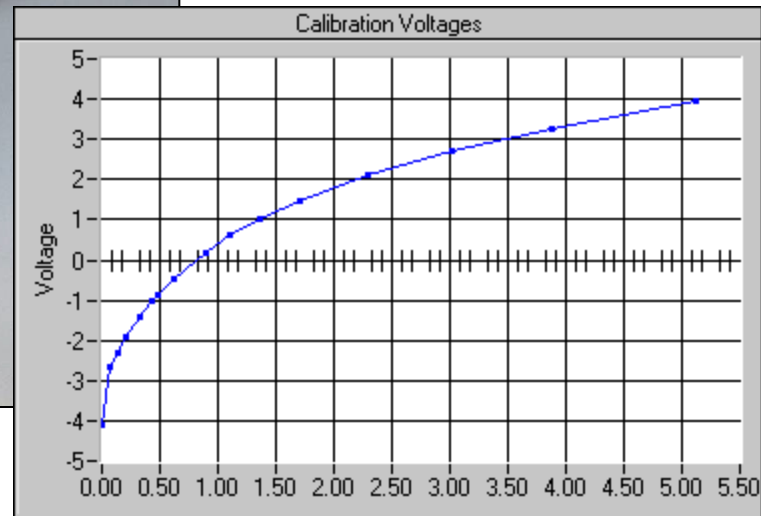
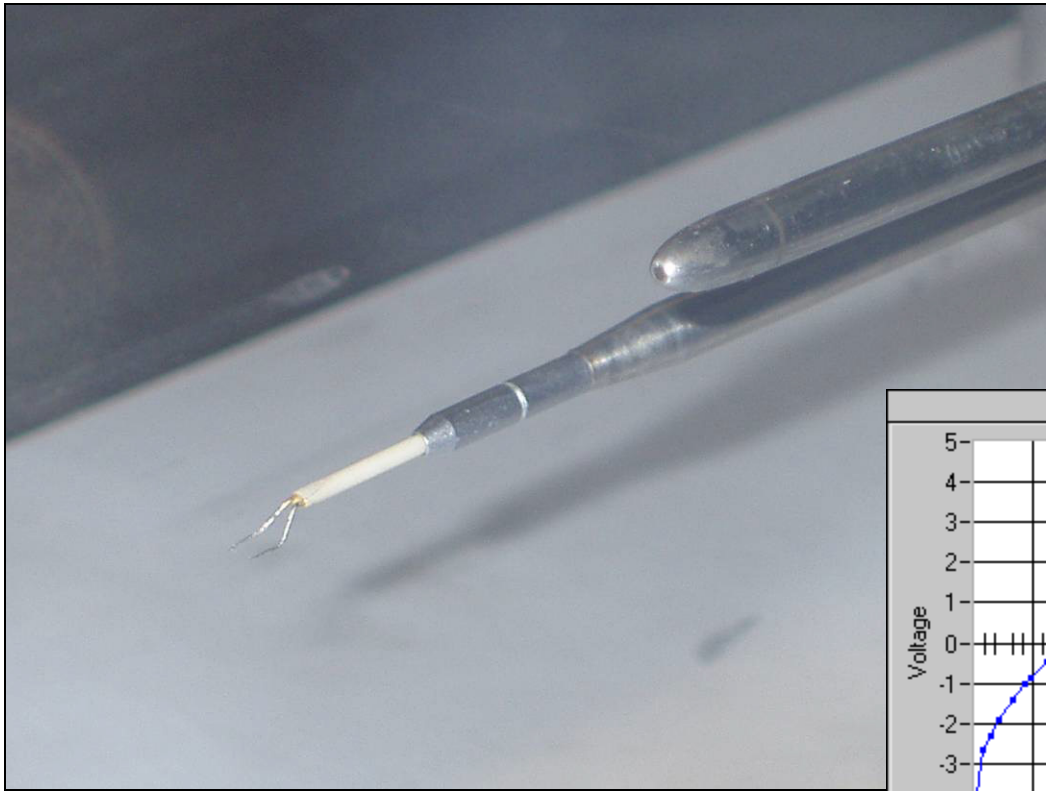


Tutorial – Hot-Wire Calibration in ThermalPro™



TSI Incorporated

Hot-Wire or Hot-Film Calibration

- The following is a brief description of the method for calibrating a hot-wire probe and take data using TSI ThermalPro™ software.
- It is meant to complement the ThermalPro manual and serve as a “Cheat Sheet” for taking data.
- For more specifics on any step, please refer to the software manual.

WARNING

The first time you use the system, be sure to go to « IFA 300/Configure/zero offset » to set the zero offset.



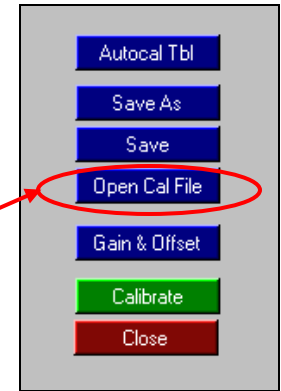
Calibration – Probe Data

- The first step is to go to:
- Calibration >> Probe Data
- The information to fill into each field is detailed on the next several slides.

The screenshot shows the 'Calibration - Probe Data' window of the IFA 300 software. The window title is 'IFA 300' and the menu bar includes 'IFA 300', 'Calibration', 'Acquisition', and 'Post Analysis'. The main area is titled 'Calibration - Probe Data' and contains the following fields and controls:

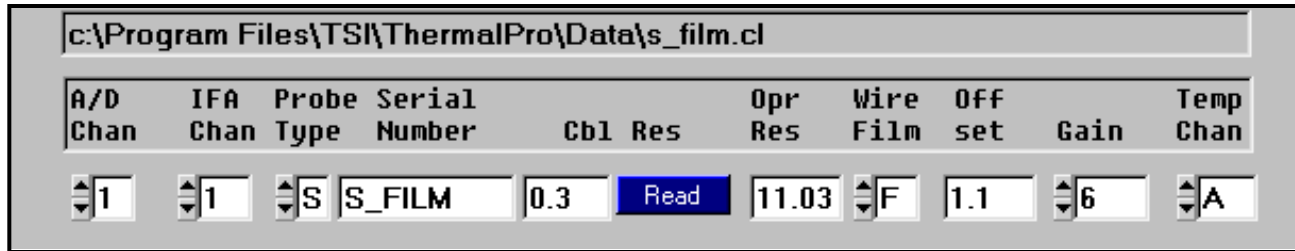
- File path: `c:\Program Files\TSI\ThermalPro\Data\s_film.cl`
- Table with columns: A/D Chan, IFA Chan, Probe Type, Serial Number, Cbl Res, Opr Res, Wire Film, Off set, Gain, Temp Chan.
- Row 1: A/D Chan: 1, IFA Chan: 1, Probe Type: S, Serial Number: S_FILM, Cbl Res: 0.3, Opr Res: 11.03, Wire Film: F, Off set: 1.1, Gain: 6, Temp Chan: A.
- Row 2: A/D Chan: 2, IFA Chan: Pressure, Probe Type: dP Signal Conditioning, Serial Number: On.
- Cal Method: 1. Acquire E & Acquire dP, Man+Tbl
- Buttons: Autocal Tbl, Save As, Save, Open Cal File, Gain & Offset, Calibrate, Close.
- IF300 sub-window: Bridge: Std, Cable: 5 Meter, Temp: 50C.

Calibration – Probe Data



- Select “**Probe Data**” from the “**Calibration**” Drop down menu.
- Click on “**Open Cal File**” (or the “**Open Cal File**” window will automatically pop up).
- Select the generic calibration file (.cal) for the type of probe you are calibrating:
 - S_film.cl – Single film sensor
 - S_wire.cl – Single wire sensor
 - X_wire.cl – Dual wire sensor, etc.
- It should be noted that the model number of your probe tells you whether it is a wire or a film sensor (e.g., 1210-T1.5). See catalog for more listings:
 - T1.5, P.5, Wire
 - 10 or 10W Film
 - 20 or 20W Film
 - 60 or 60W Film
- Click **OK**, then click “**Save As**” and save the calibration file as the serial number of your probe (e.g., 70412134.cl)

Calibration – Probe Data

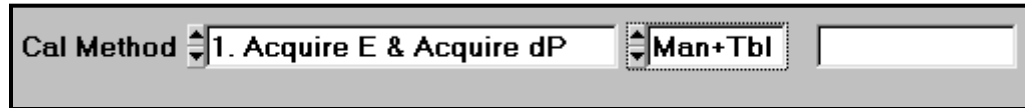


A/D Chan	IFA Chan	Probe Type	Serial Number	Cbl Res	Opr Res	Wire/Film	Off set	Gain	Temp Chan	
1	1	S	S_FILM	0.3	Read	11.03	F	1.1	6	A

- Click **OK**, then enter the data on the line:
 - **“A/D Chan”**: Which channel on the A/D Connector board
 - **“IFA Chan”**: Which channel on the IFA300
 - **“Probe Type”**: Click on the field for a list of choices (S = Single Sensor)
 - **“Serial Number”**: typically we save the calibration file as the serial number.
 - **“Cbl Res”**: Here you enter the cable resistance. This can be determined by hitting the **“Read”** button and following the steps. Be sure to use the shorting plug in the probe support.
 - **“Opr Res”**: Operating resistance of the probe. This is found on the probe box.
 - **“Wire/Film”**: Enter “W” for wire or “F” for film.
 - **“Offset and Gain”**: These can be determined using the “Gain and Offset Calculator” Button.
 - **“Temp Chan”**: Click on the field for a list of choices. “A” means you are using a standard type-T thermocouple as typically supplied with the system.

Calibration – Probe Data

- If you are using a **pressure transducer** (such as with the TSI calibrator model 1128 or 1129), the pressure BNC should go to the A/D channel directly after the probe (e.g., If the probe is in channel 1, the pressure should go to channel 2 on the A/D board).
- For **“Cal Method”**, below are the two most common uses:
 - **“1. Acquire E & Acquire dP”**: This is used with the calibrator.
 - **“3. Acquire E & Type Velocity”**: For example if you are calibrating against a Pitot tube or for a wind tunnel application.



- There is a field to the right of **“Cal Method”** where you can select how you want to calibrate. This is only used with a calibrator.
 - **“Manual”** means you will select the points yourself.
 - **“Man+Tbl”** means you would like ThermalPro to suggest the calibration points to use (this is the suggested method if you have a manual calibrator).
 - **“Auto”** is used if you have an auto calibrator (model 1129).

Calibration Table

- If you selected “**Man+Tbl**”, you have to tell ThermalPro the details of your flow.
- Go to “**Calibration**” >> “**Autocalibration Table.**”
- Then click on “**Create New.**” Fill in the information for your calibrator, and also fill in the information for the atmospheric temperature and pressure. Also fill in the min and max velocity.

The screenshot shows the 'Auto Calibrator' software window. The title bar includes the TSI logo and the text 'Auto Calibrator'. Below the title bar are tabs for 'Table Editor', 'Create New', and 'Definitions'. On the right side of the window, there are buttons for 'CTB File', 'Open', and 'Save'. The main interface is divided into several sections:

- dP Conditions:** Includes input fields for 'dP Full Scale' (100.000 mm Hg), 'mm Hg = 5.1 Volts', 'Volts at dP = 0.00' (-4.9 Volts), and 'dP/V' (10.000). There are also spinners for 'Num Pts' (17) and a 'Best # Pts' button.
- Conditions:** Includes input fields for 'Cal Pressure' (760.00 mm Hg) and 'Cal Temperature' (20.0 C), both with unit dropdowns. There is also a 'Nozzle' spinner set to 1.
- Velocity:** Includes input fields for 'Exit Vel (m/s)' with 'Max' (50.000) and 'Min' (0.000) values, and 'dP (mmHg)' with 'Max' (11.410) and 'Min' (0.000) values.
- Use with TSI Model 1129 Autocalibrator?:** A dropdown menu currently set to 'Yes'.
- Buttons:** A 'Calculate' button is located at the bottom right.

Calibration – Probe Data

- Save it.
- Back on the **“Probe Data”** screen, click on **“Open Cal File”** and select the one you just made.
- There is a box called **“IFA300.”** In this box, make sure the settings are correct. The defaults are the standard system settings.
- Click on **“Save.”**
- Click on **“Calibrate”**
- You may hear some clicking sound coming from the IFA300. This is normal.

Calibration – Conditions Setup

- The next screen will look like this:
- Here is where you enter the current Atmospheric Pressure [Atm Press (Use units of mmHg)] and the Current Temperature of the lab where the probe is (Cal. Temp). You should also set the Minimum and Maximum velocities that you plan to calibrate to.
- In the field on the right labeled “# Points,” you can input the number of calibration points. A good calibration will have at least 15 points.
- Hit the “**Acquire**” button. When you do, you will see a couple of windows asking you to do something. These are shown on the next slide.

IFA 300
IFA 300 Calibration Acquisition Post Analysis

Calibration - Conditions Setup

0 Master Count

Cal File 46237.CL S Single Get Cal File

Conditions

Atm Press 740.00 mm Hg Units
Cal Temp 23.4 C Units dP Gain 10
Opr Temp 250.00 C
Min Velocity 0.00 m/s Units
Max Velocity 5.00 m/s Units
Cal Method 1. Acquire E & Acquire dP
dP Units mm Hg Man+Tbl

dP Conditions

dP Full Scale 100.000 mmHg = 5.1 Volts dP/V
Volts at dP = 0.00 -4.90 Volts 10.000

Acquire Cal Point

16 # Points
1 Next Point
YP Vel 1 Velocity
Acquire

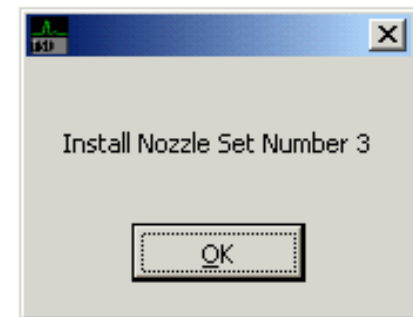
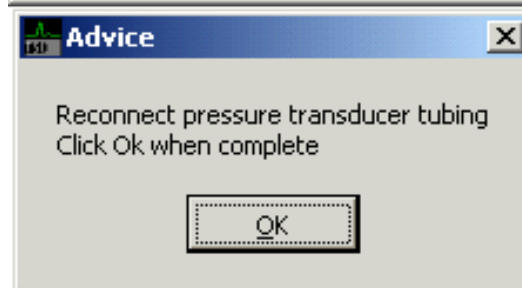
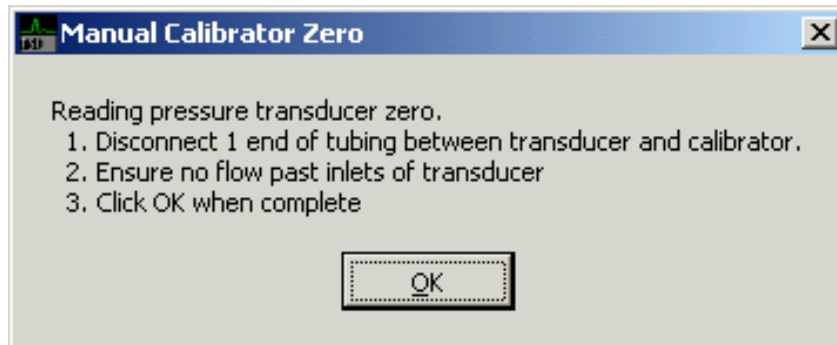
Actual	Target
0.464	0.000
0.0009	0.0000

Sequence
Down Up

Test Show Graph Next Screen Close

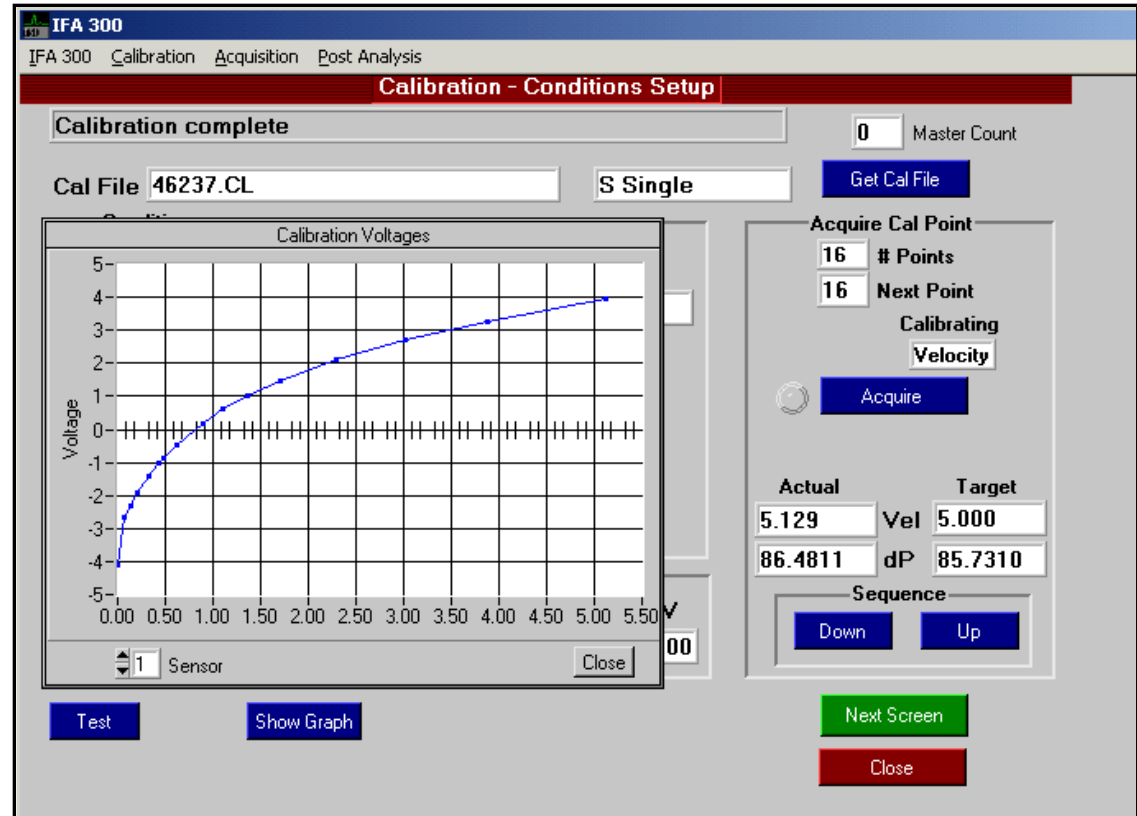
Calibration – Conditions Setup

- Follow the instructions given in the windows, and click “**OK**” when complete.
- If you are using the calibrator, please be sure that you are using the correct Nozzle set (refer to the calibrator manual for the nozzle set definitions).



Calibration – Conditions Setup

- Hit the “**Acquire**” button again and you will take your first calibration point.
- If you are using the calibrator with the autocalibration table, you can increase the velocity until the “**Actual**” matches the “**Target.**” This need not match exactly, so do not spend too much time trying to get it perfect.



- In general for a calibration, you will want more data points where the calibration curve gradient is largest, namely near the beginning (the autocalibration table does this automatically). In addition, you may want to have a few extra data points near the velocity where you will be taking most of your data.

Calibration – Data Table

- When you have obtained all of the calibration points, hit “**Next Screen**” and you will be directed to a screen similar to the one at the right.
- This is a table showing your calibration points.
- Click on “**Curves**” to select and view the curve fit you would like to use for your data.
- *Note: If you do not click on the “**Curves**” button, the calibration will not be saved!*

IFA 300
IFA 300 Calibration Acquisition Post Analysis

Calibration - Data Table

Probe Serial #: 46237

Cal Point	Bridge Voltage	Bridge Voltage	Bridge Voltage	dP	Actual Velocity	Temp
1	1.1376			0.0001	0.00	21.85
2	1.3777			0.0116	0.08	21.91
3	1.4384			0.0324	0.13	21.81
4	1.5024			0.0829	0.21	21.79
5	1.5829			0.2134	0.33	21.91
6	1.6459			0.4035	0.43	21.78
7	1.6765			0.5358	0.49	21.78
8	1.7411			0.9372	0.62	21.75
9	1.8518			2.2016	0.89	21.90
10	1.9219			3.6025	1.11	21.92
11	1.9905			5.6705	1.36	21.95
12	2.0657			9.0763	1.71	21.91
13	2.1696			16.6779	2.29	21.80

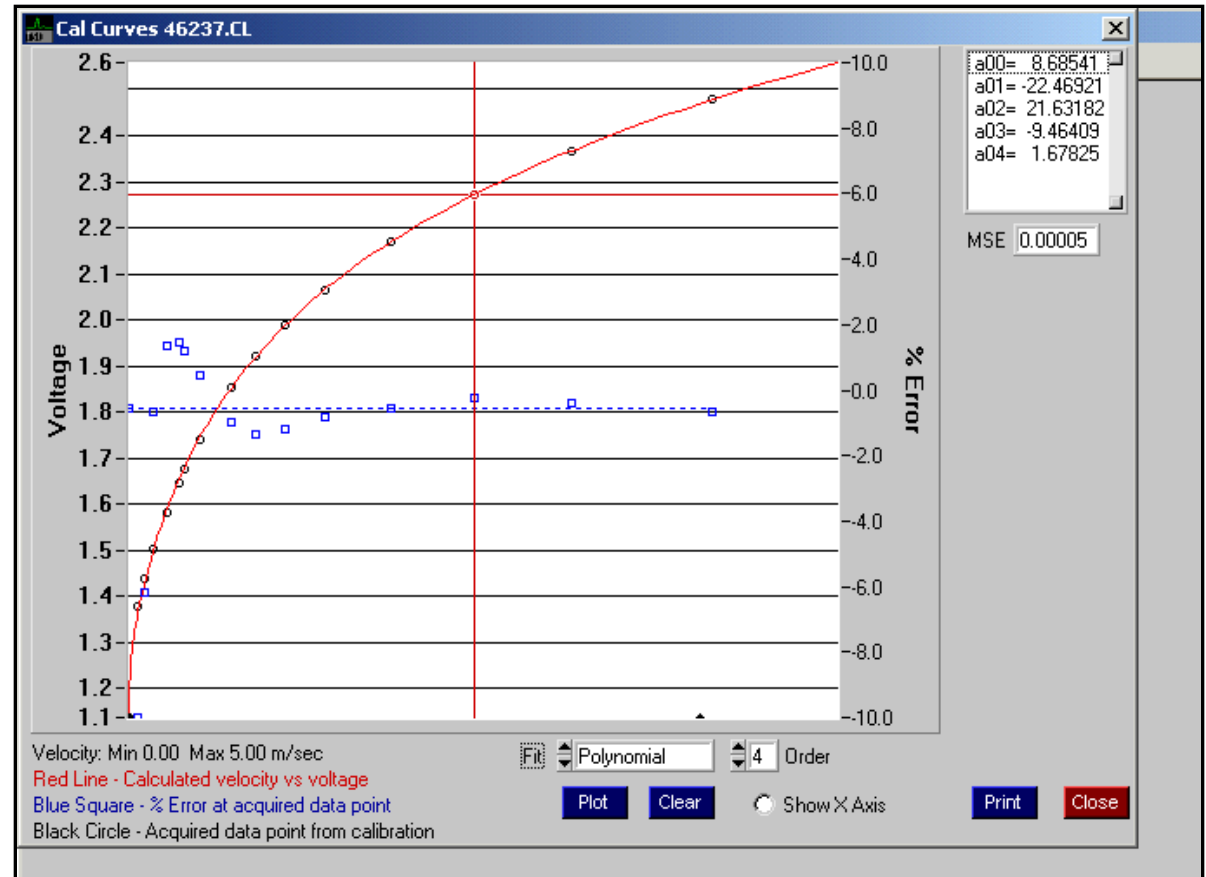
Cal Pt El Volts dP Act Vel

0 0.0000 0.0000 0.0000

Edit Line
Save Line
Insert Line
Delete Line
Print Table
Curves
Close

Calibration – Data Table

- On the calibration curves screen, you can select the “**Fit**” that you want (e.g., 4th Order Polynomial, Kings Law, etc.)
- For more details about these curve fits, please refer to the manual.
- After you select the “**Fit**” you want, click “**Plot.**” The calibration has now been saved.
- The Red line represents your curve fit, and the blue squares represent the % error of each data point from the curve. It is normal for the error to be larger for the lower velocity points.



- When using the calibrator, the error should be less than a couple of percent for all but the very lowest calibration points.
- Click “**Close.**”

Conclusion

- Congratulations! You are now ready to take data with your hot-wire or hot-film probe.

