

Fire Science Laboratory

Troubleshooting Guideline

This troubleshooting guideline provides a procedure to help the student track down problems in their experimental setup. Several problems that are commonly encountered are also addressed.

The lab has many excellent reference sources readily available to help you understand equipment and instrumentation used in the lab.

Use them... they will help save you a lot of time !

Procedure for tracking down problems

The best thing you can do to track down your problem quickly and with the least amount of headache is to work in a methodical manner. This means to start very simply with one component by itself and as that item is determined to work correctly, to move onto the next component. When all components are determined to work independently, add them to the system one at a time. It is easiest to work from the computer “outward” to the sensor.

For example, assume that you have a pressure transducer that has its voltage read by a data acquisition system and a spreadsheet is used to get pressure from this voltage. You think the pressure you get from the spreadsheet is wrong. You would first check that the computer itself is working ok. Then, add in the data acquisition system and check that it is working right by applying a known voltage input by using a voltage supply. Check the output from the pressure transducer when applying a known pressure. You would then check that the spreadsheet is working ok by again, using a known input and seeing that the output is as expected.

Check each component against a known reference one at a time. This means to check each component with other equipment and not the items in your setup.

1. Define the symptom. *An incorrect value? A high or low signal? No signal? Intermittent or consistent?*
2. Check that the computer is working properly. *Is it crashing? Is it on?*
3. Check that each component is working properly. *Does a thermocouple give the correct reading for ice and boiling water ? Does a pressure transducer give the right reading when a known pressure is applied? Is the “zero” case correct?*
4. Confirm that you are within the limitations of equipment. *Are you trying to acquire a signal that is too fast for the way you have setup the equipment?*

5. Check that the correct coupling is being used. Is the output of the sensor *DC or AC?*
6. Confirm calibration of the sensor is up to date. *Calibration of sensors drift.*
7. Review your spreadsheet and calculations. *Is there an error?*
8. Look for vibrations. *Vibration can cause electrical noise and weird signals.*
9. Talk to advisor and others about problem. Maybe someone else has already solved this problem.
10. Ask yourself the question “What if each component didn’t work?” *What would be the manifestation? Are you seeing anything that looks like that?*

If you have tried all of the above, found no problems and still have an answer you think is wrong, ask yourself “Is my result true?” Maybe your result is the correct answer and someone else you are comparing to is wrong. Just because something is unexpected doesn’t mean isn’t right. Observe, question and understand what you are doing.

Commonly Encountered Problems

1. Thermocouples

Thermocouples need to be read with the proper device. The lab multimeter has a thermocouple readout for type K. It will not read any other type thermocouple.

If you are using Labview, insure that you are using a SCXI module capable of reading thermocouples. The 1102C module with a 1303 accessory is typically used in the lab. Also check to confirm the proper hardware setup is active (this is accomplished in the Measurement Automation program) and that the channel is set to read the type of thermocouple you are using.

If you are using some other hardware/software, insure that it can read thermocouple outputs. You can not just directly read the voltage because it is in the millivolt noise range and you would have to convert it using the complicated formulas found in thermocouple tables. Also, check what type of cold junction compensation is needed or provided.

Thermocouples are polarized and must be hooked up correctly. For type K, red is negative and yellow is positive. Check specs (found in Omega catalog or in references drawer) to get color identification for other type thermocouples.

An intermittent incorrect reading or spiking is usually indicative of reversed polarity. That is, you have switched the positive and negative wires. Check all connections from thermocouple to readout indicator.

A very large reading (positive or negative) indicates an open circuit or a loose connection.

A kink or exposed spot in the wires can lead to an additional unwanted junction. This wire must be replaced.

Remember that thermocouples are typically only valid to $\pm 2^\circ$. Check specs (found in Omega catalog or in references drawer). If you want better resolution, get a “special standards of error” thermocouple or use an RTD instead.

If all of the above has been checked, insure thermocouple is operating properly by rechecking (you should have already done this before using the thermocouple) its' reading with ice water or boiling water. If it is way off, then the thermocouple may be no longer valid. Replace.

2. Data acquisition system

If you are using Labview, insure that you are using a SCXI module capable of reading the output of your sensor. Most sensors are voltage output. The 1102C module with a 1303 accessory is typically used in the lab to read voltage as well as thermocouples. Check that the channel is set to read the sensor output and range (this is configured in the channel wizard).

If you are using some other hardware/software, insure that it can read the output of your sensor.

Do a continuity check of wires by resistance. Use the highest level on the multimeter. OL means open circuit and the wires/connections are bad.

If using Labview, insure chassis is on and attached to the computer via cable to slot 1, which should have a module in it. Confirm chassis, modules and accessories are configured correctly. Then check that the channel setup is matched to your experiment.

SHUT OFF POWER BEFORE YOU INSTALL/REMOVE MODULES !!!

Be very careful when installing modules and accessories as the pins are very fragile and break if forced.

The National Instruments Measurement and Automation Program is where the hardware is configured. The type of chassis, modules and accessories are defined here, as well as the channel setup. The board in the computer is a DAQ device and the chassis and modules are SCXI devices.

When you activate the Measurement and Automation program, three choices will come up in the left side of the windows explorer format. These are

Devices and Interfaces
 Data Neighborhood
 Scales

It is easiest to do your set up/check out in the following order

1. Devices and Interfaces
2. Data Neighborhood
3. Scales
4. Save with a new name descriptive of your setup

1. Double click Devices and Interfaces (on the left side) and the menu expands to show the device and chassis

Measurement and Automation
 Devices and Interfaces
 PCI-MIO-16XE-10 Device
 SCXI-1000 Chassis
 Data Neighborhood
 Scales

Double click PCI-MIO-16XE-10 Device on the left side and see two attributes (Device Number and Serial Number) listed on the right. Double click either attribute on the right side to get the Device dialog box to pop up. This dialog box has 5 tabs and the required values are listed below.

<u>Selection</u>	<u>Value</u>
System	device 1
AI	+/- 10 V, differential mode
AO	bipolar
Accessory	none
OPC	disabled

Double click SCXI-1000 Chassis on the left side and see the menu expands to show the installed modules. (The ones listed below are only an example listing, there may be different ones actually installed)

Measurement and Automation
 Devices and Interfaces
 PCI-MIO-16XE-10 Device
 SCXI-1000 Chassis
 Module 1, SCXI 1102B
 Module 2, SCXI 1102B
 Empty
 Data Neighborhood
 Scales

Double click each and see 3 attributes (Attached Accessory, Cabled Device and Operating Mode) listed on the right. Double click any attribute on the right side to get the Chassis dialog box to pop up. This dialog box has 3 tabs and the typical values are listed below.

Module 1 MUST be the ONLY module attached to the PCI-MIO-16XE-10 Device and should have the “controller” box checked off. All others should be attached to NONE.

<u>Selection</u>	<u>Value</u>
General	none, multiplexed
Channel	all, gain 1.0*
Accessory	1303*

* These are typical but put in your specific values if you want a different *gain* (*it is highly recommended to always use a gain of 1*) or are using a different accessory.

2. Double click Data Neighborhood (on the left side) and the menu expands to show all the current channels. (The ones listed below are only an example listing)

Measurement and Automation
 Devices and Interfaces
 Data Neighborhood
 Channel 1
 Channel 2
 Scales

Double click each and see 5 attributes (Channel Name, Channel Type, Channel Description, Device Channel and Device Name) listed on the right. Double click any attribute on the right side to get the Channel dialog box to pop up. This dialog box has 8 values listed below that you will assign. The channel name will be used to interact with the VI.

<u>Selection</u>	<u>Value</u>
Name	
Description	
Units	
Sensor Type	
Scaling	
Misc	
Hardware	Channel → The physical channel you will use Device → The module slot and chassis

3. Double click Scales (on the left side) and the menu expands to show the custom scales

- Measurement and Automation
 - Devices and Interfaces
 - Data Neighborhood
 - Scales
 - Custom 1

Double click each and see 2 attributes (Name and Type) listed on the right. Double click any attribute on the right side to get the Scales dialog box to pop up. This dialog box has several values that you will assign. *It is highly recommended to not use any custom scales!*

3. Pressure transducers

Strain gage type pressure gages require an excitation voltage. Piezoelectric type gages do not. Check specs to determine what excitation voltage you need. If you use an AC to DC converter, you will most likely pick up 60 Hz line noise.

A very large reading (positive or negative) indicates an open circuit, a loose connection or no excitation.

If you are using Labview, insure that the proper SCXI module is used and the channel is set to read the type of output the gage has. This is usually current. The module for a current output strain gage type pressure transducer is SCXI 1121 with a 1321 accessory.

Pressure transducers have a rated frequency response. This is limited to the slowest response of the *entire* system including the data acquisition system. If you try to obtain data faster than this, the data will not be a true representation of the actual pressure change. Check the hardware/software setup.

4. Heat flux gages

Gage must be water cooled. Insure water is running!

Insure you are using the proper calibration curve for the gage. Check the serial number. Understand whether the calibration is incident or absorbed. The calibration may be out of date and as such the heat flux gage may need to be re-calibrated. See lab staff for help.

Although Medtherm gages can over range to 150 %, to avoid damaging a gage, insure you are using a gage capable of handling your heat flux range.

5. Electrical noise

60 Hz is almost always line power noise. The power line needs a 60 Hz filter.

Spikes that are seen in data acquisition are usually a manifestation of a high frequency noise signal coming in through the power line. Use an oscilloscope to see what the actual noise signal looks like. Possible RFI filter power line or some data acquisition systems have high frequency filters built in. Check settings.

EMI noise can come through the air. Proper shielding of signal wires will help block this. Ground shield at only one end of the wire (usually, all at the data acquisition board). Run signal wires away from power wires, especially high voltage. Coiled wires can create it's own magnetic field. Do not coil unshielded signal wires.

6. Flowmeters

The marks on variable area flowmeters (i.e, rotometers) are the flowrates for standard conditions (standard temperature and pressure). You need to do a correction for pressure if you are using it with pressure. This correction equation is found in the references drawer of the file cabinet.

7. Cone

The main breaker needs to be on.

Laser un-alignment will cause smoke density measurement problems. See lab staff for help.