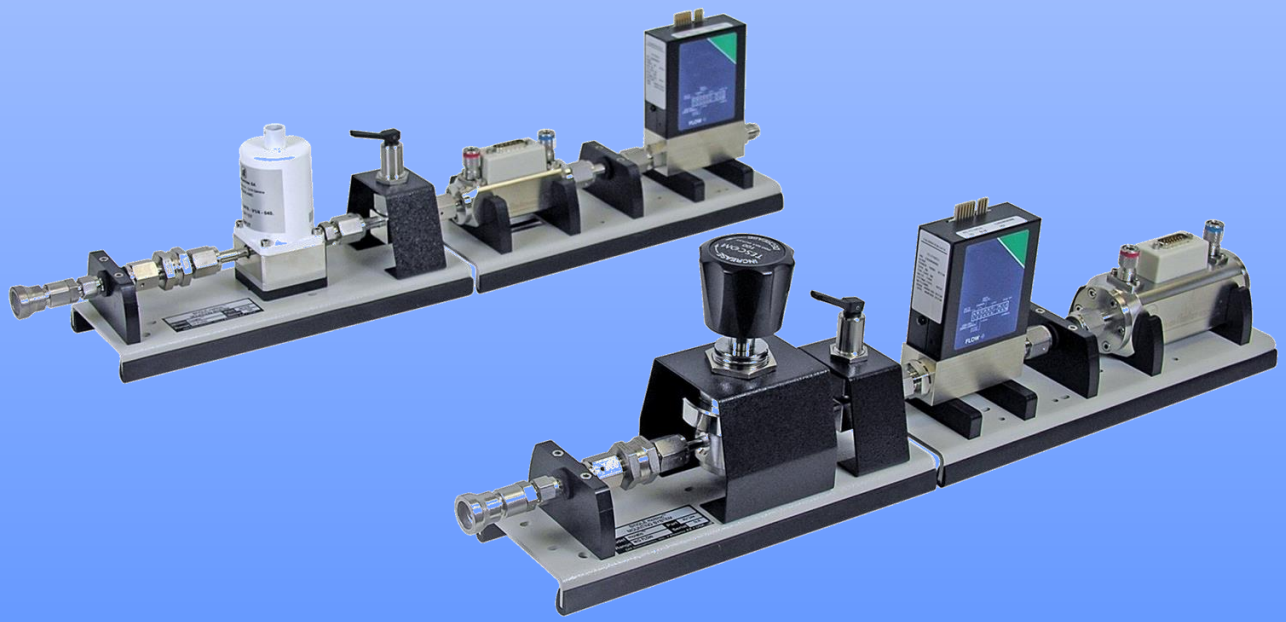
FLUKE®
Calibration

COMPASS for Flow

Introduction, Overview, and Structure



What is flow calibration?

A series of comparisons under specified conditions of applying a known flow to a flow measuring Device Under Test (“D.U.T.”) over its measurement range in order to determine or verify the relationship between flow input and the DUT’s output.

<u>Required components</u>:

- **DUT(s)**
- **Reference flow device**
- **Flow control hardware**
- **Measurement and/or control hardware for other parameter(s) (e.g. temperature, humidity, etc.)**
- **Data acquisition and interconnection hardware**

What is flow calibration?

The process includes the following steps:

- **Connecting the DUT together with the reference**
- **Generating and controlling the applied flow**
- **Reading the DUT**
- **Reading the reference device**
- **Comparing values**
- **Determining in / out of tolerance**
- **Adjustment of DUT (if necessary)**
- **Verification of adjustment (if necessary)**
- **Reporting results**

Benefits of calibration automation

Why should you automate pressure calibration?

Benefits realized through automation:

- **Reduction of operator error**
- **Electronic records of results**
- **Long and complicated tests can be accomplished unattended or overnight**
- **Improved lab efficiency**
- **Standardization of operational procedures; leak test, exercise, tare, dwell time, ready/not ready, data collection**
- **Software configurations can be readily duplicated by multiple operators, in multiple locations.**

Levels of calibration automation

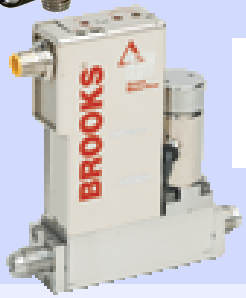
FLUKE® Calibration

The level of test automation possible depends on the type of DUT being tested, the reference and the flow control hardware

Visual interface or manual control

Manual, User-Assisted Data Acquisition or control

Devices that don't output in flow units (Analog or pressure output devices)



Full Data Acquisition or control, through other Support Devices (DMM, pressure sensor, etc.)

Digital output devices

digital gauges
MFC, MFM
digital meters

Full Data Acquisition

COMPASS features

COMPASS for Flow calibration software is PC software designed to assist in the flow calibration process

- **Manual, semi-automated, or fully automated data entry (or combination of)**
- **Manual (user chosen) or pre-defined test point sequences (test files)**
- **Support of 3rd party (non-Fluke Calibration) references**
- **Data saved in unique data files, and in a database**
- **Calibration report generation tool included that is configurable**

Setting up and running COMPASS

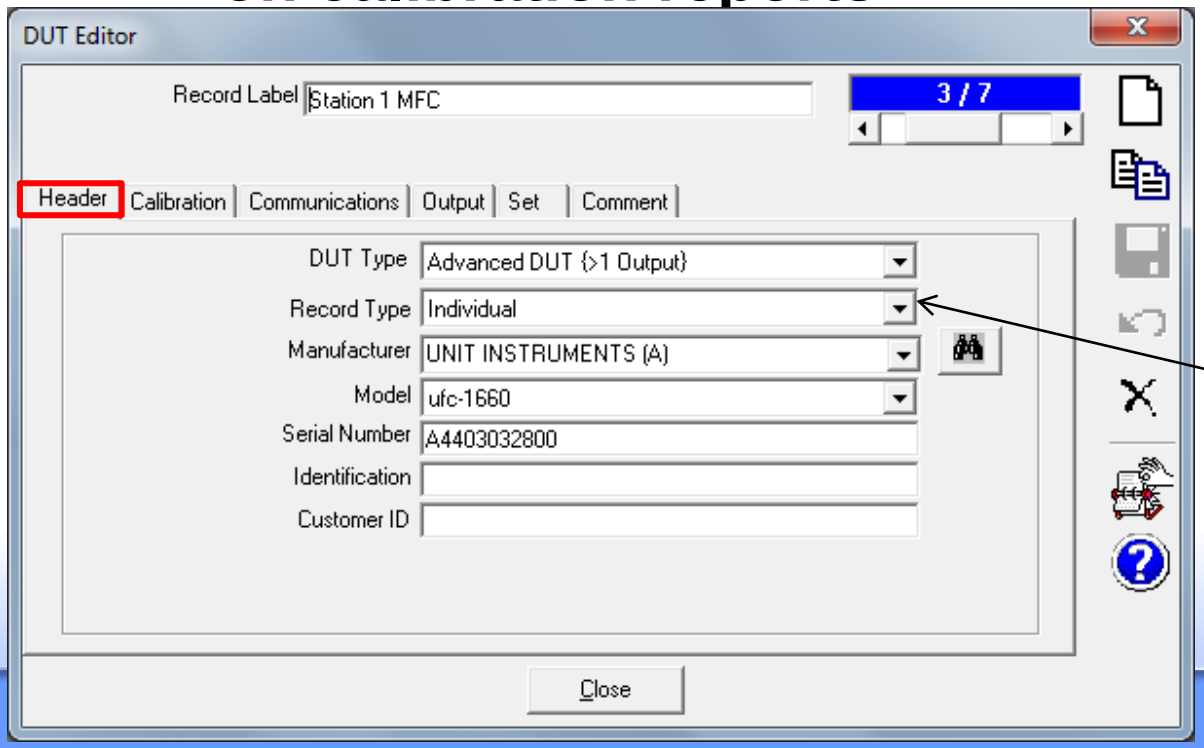
- Setup Devices
  - Setup DUTs
  - Setup Support Devices (all non-DUT devices)
- Setup Test(s)
- Setup options, default hardware
- Setup/edit calibration report template(s)

Above steps take time but are typically done once, then maybe partially for new devices

- Run Test
- Create calibration report

Setup devices (10 sccm MFC example)

- **Setup DUTs**
  - **Enter for all devices: manufacturer, model, serial number, ID, unit, min/max range, tolerance, raw output(s), final output, remote command(s), etc.**
  - **Entered info can be used during test and/or shown on calibration reports**



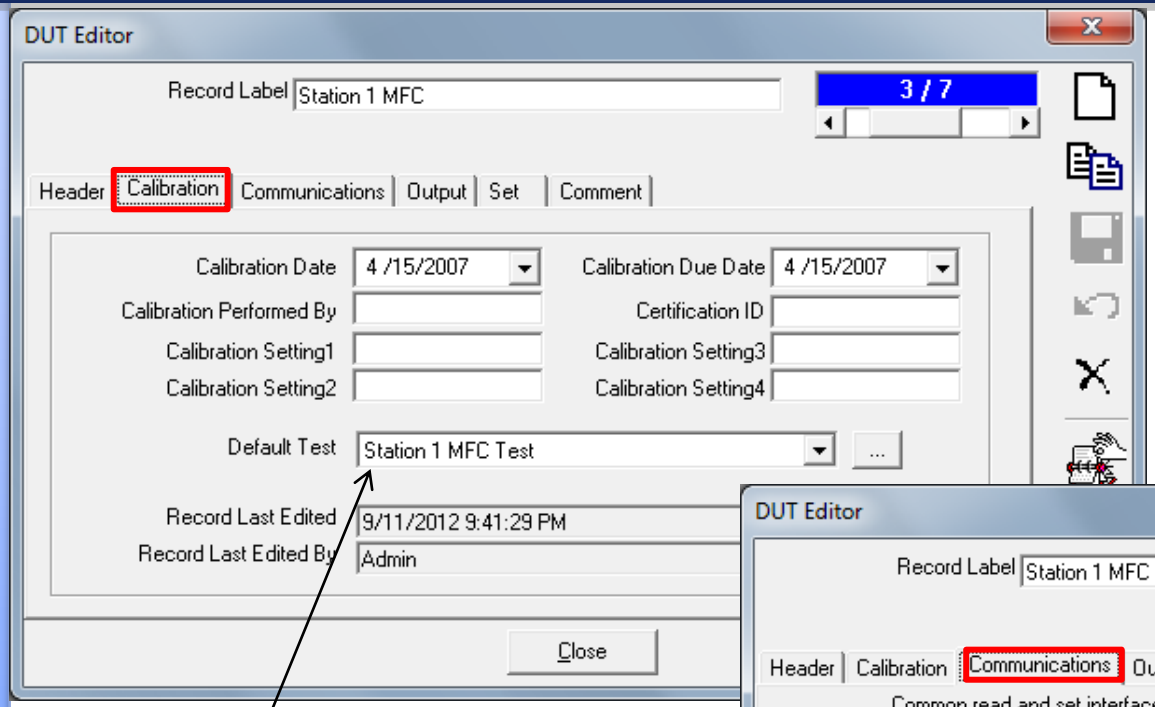
DUT Type:

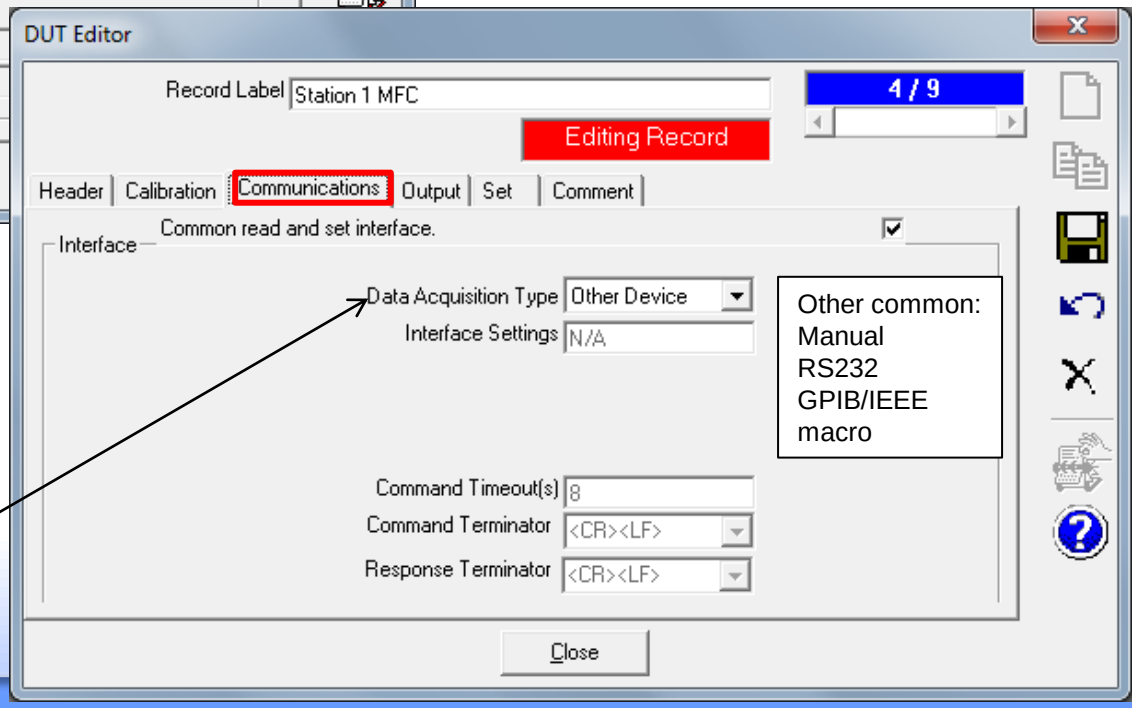
- **Advanced - More than one output (read flow, set flow, pressure, temperature)**
- **Simple – One output**

Record Type:

- **Individual – Unique device with SN, ID, etc.**
- **Profile – Template, enter unique info when starting test**

Setup DUT, cont.



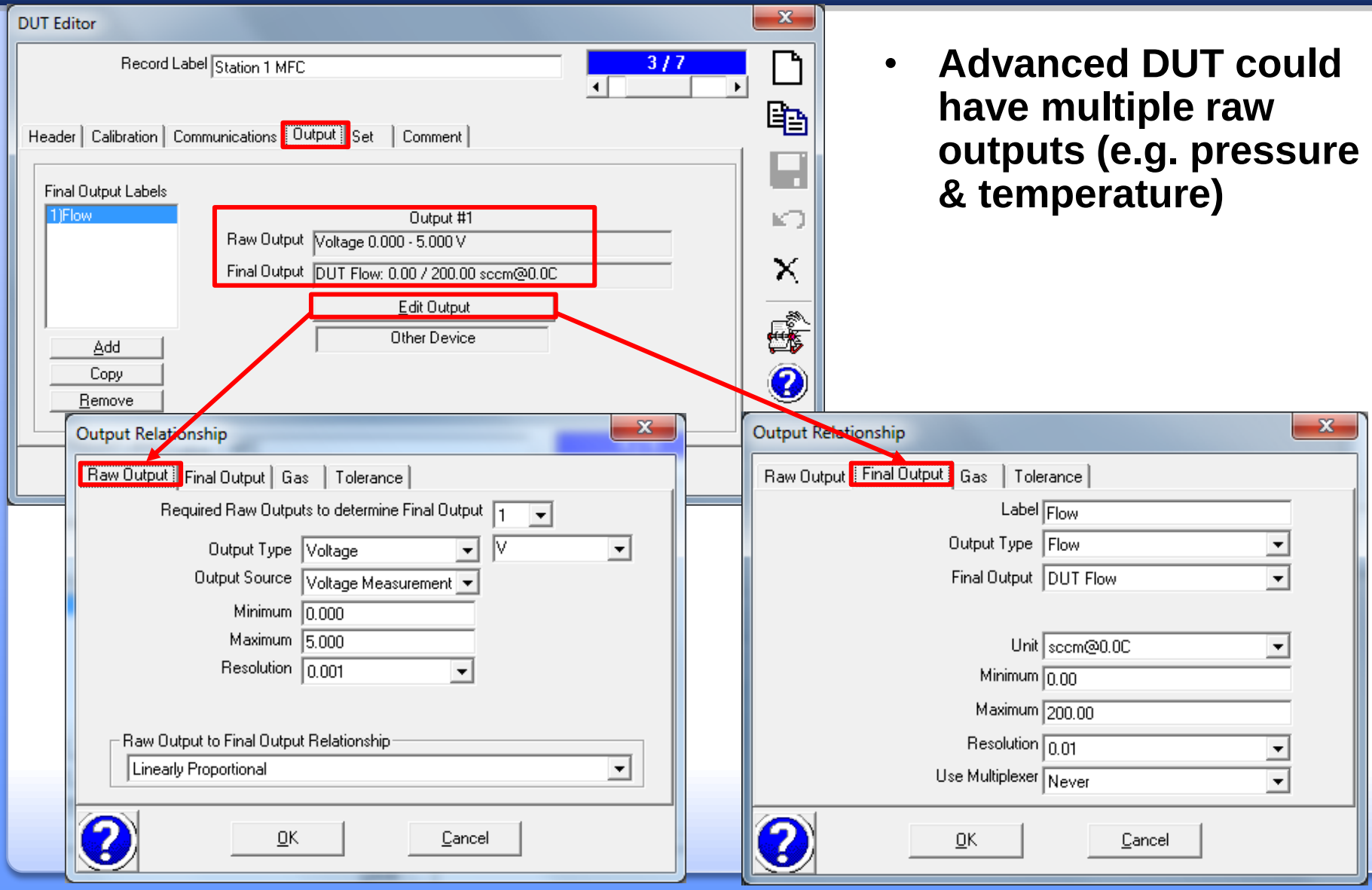


Specify the Test so the technician doesn't have to when doing the calibration

MFC is read/set through "Other Device" (DMM)

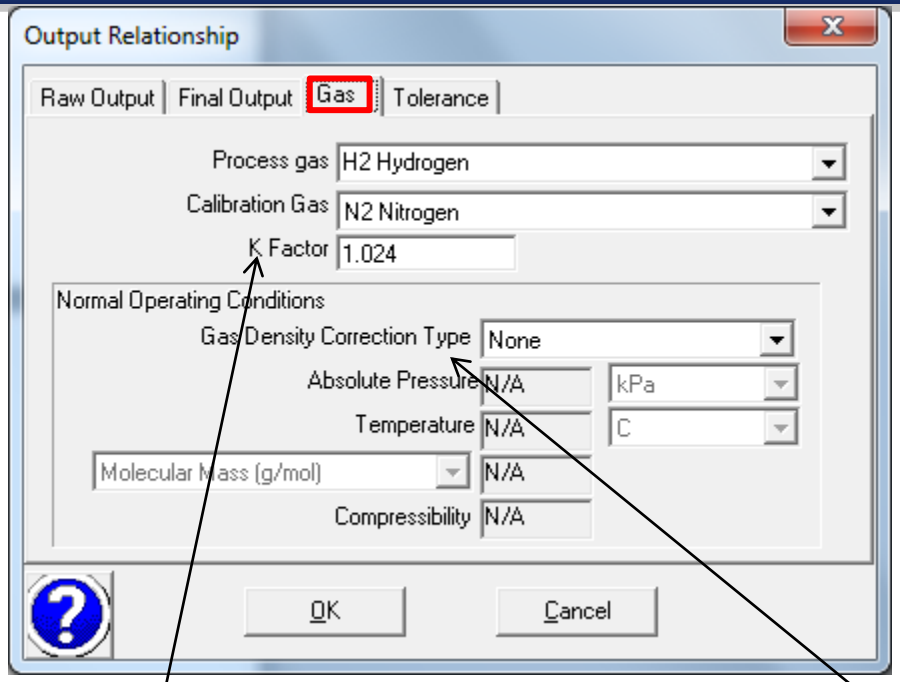
Other common:
Manual
RS232
GPIB/IEEE
macro

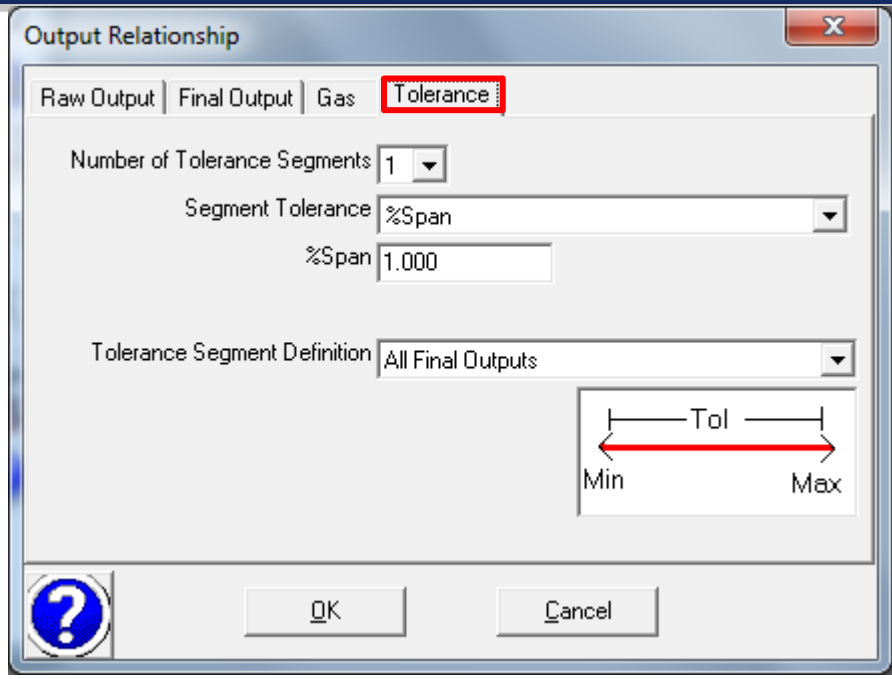
Setup DUT, cont.



- **Advanced DUT could have multiple raw outputs (e.g. pressure & temperature)**

Setup DUT, cont.

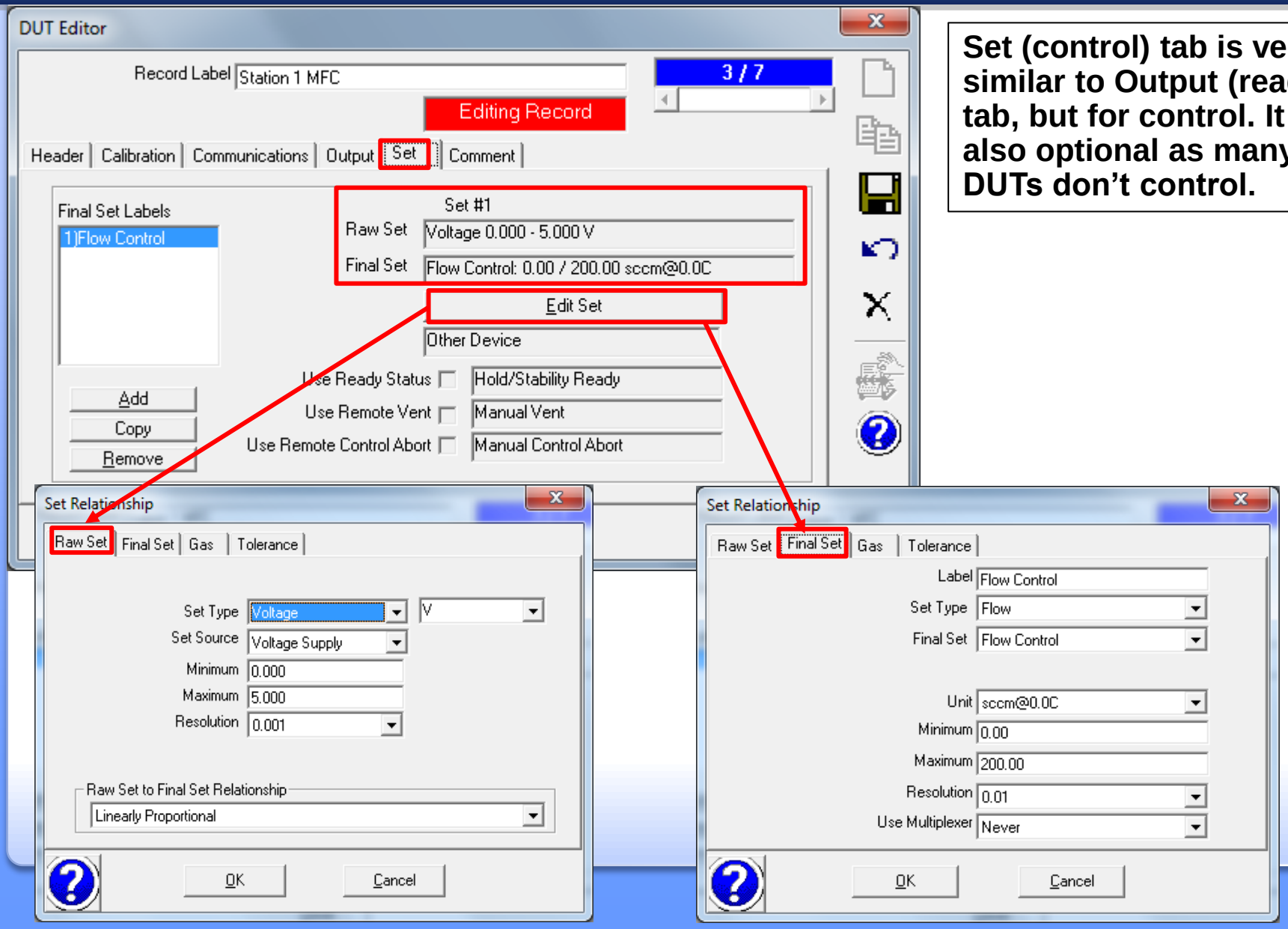




K Factor for thermal mass flow devices running a different gas

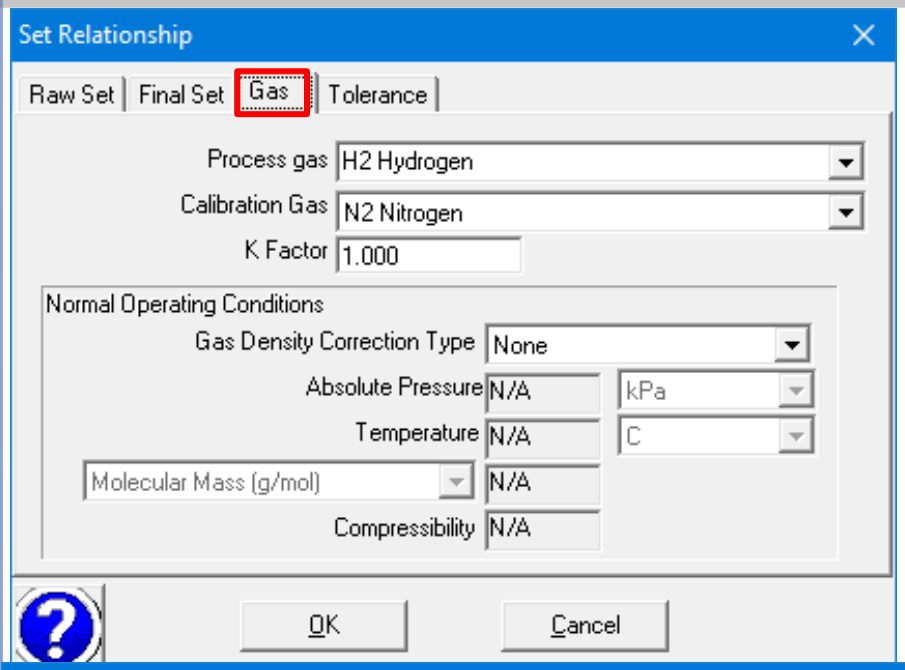
Gas density correction used for rotameters and other density dependent DUTs. Proportional or square root density correction. Must specify normal (design) pressure and temperature

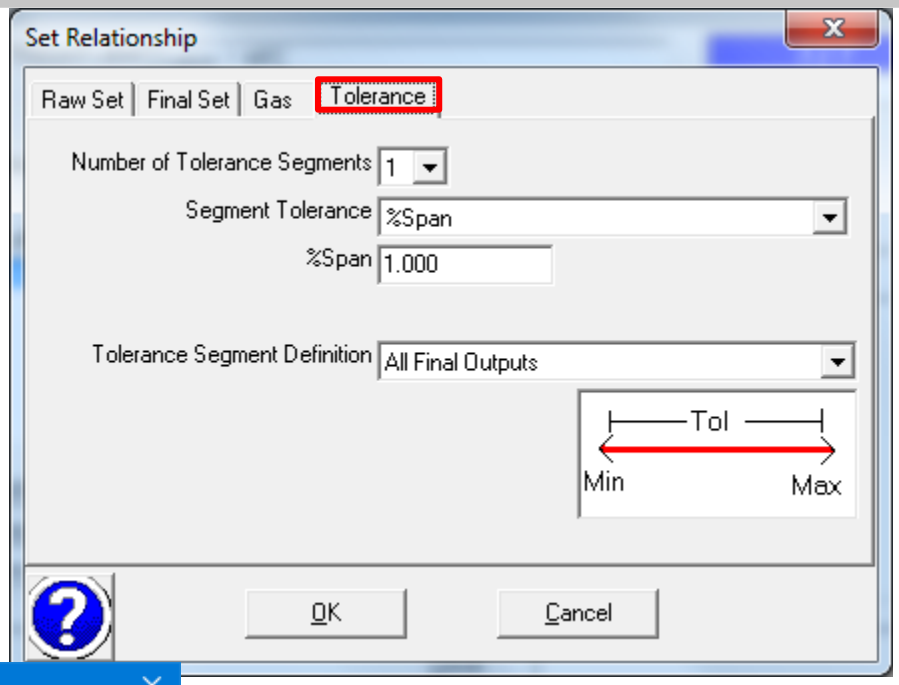
Setup DUT, cont.

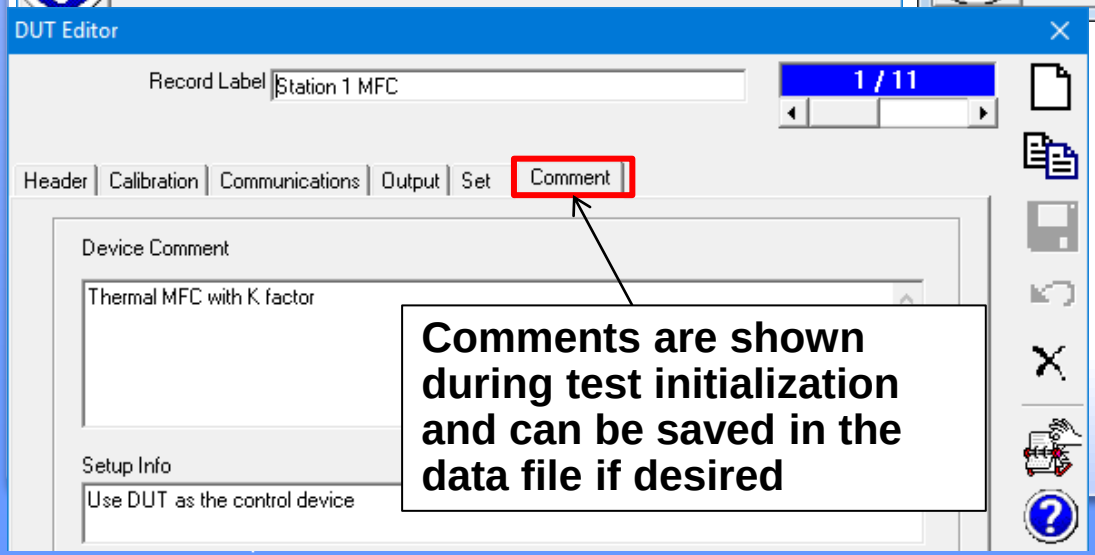


Set (control) tab is very similar to Output (read) tab, but for control. It is also optional as many DUTs don't control.

Setup DUT, cont.







Comments are shown during test initialization and can be saved in the data file if desired

Set (control) tab is very similar to Output (read) tab, but for control. It is also optional as many DUTs don't control.

K Factor is 1 on the Set tab. If I set 1 volt to the MFC, I want it set as 1 volt, and don't want to double the K factor

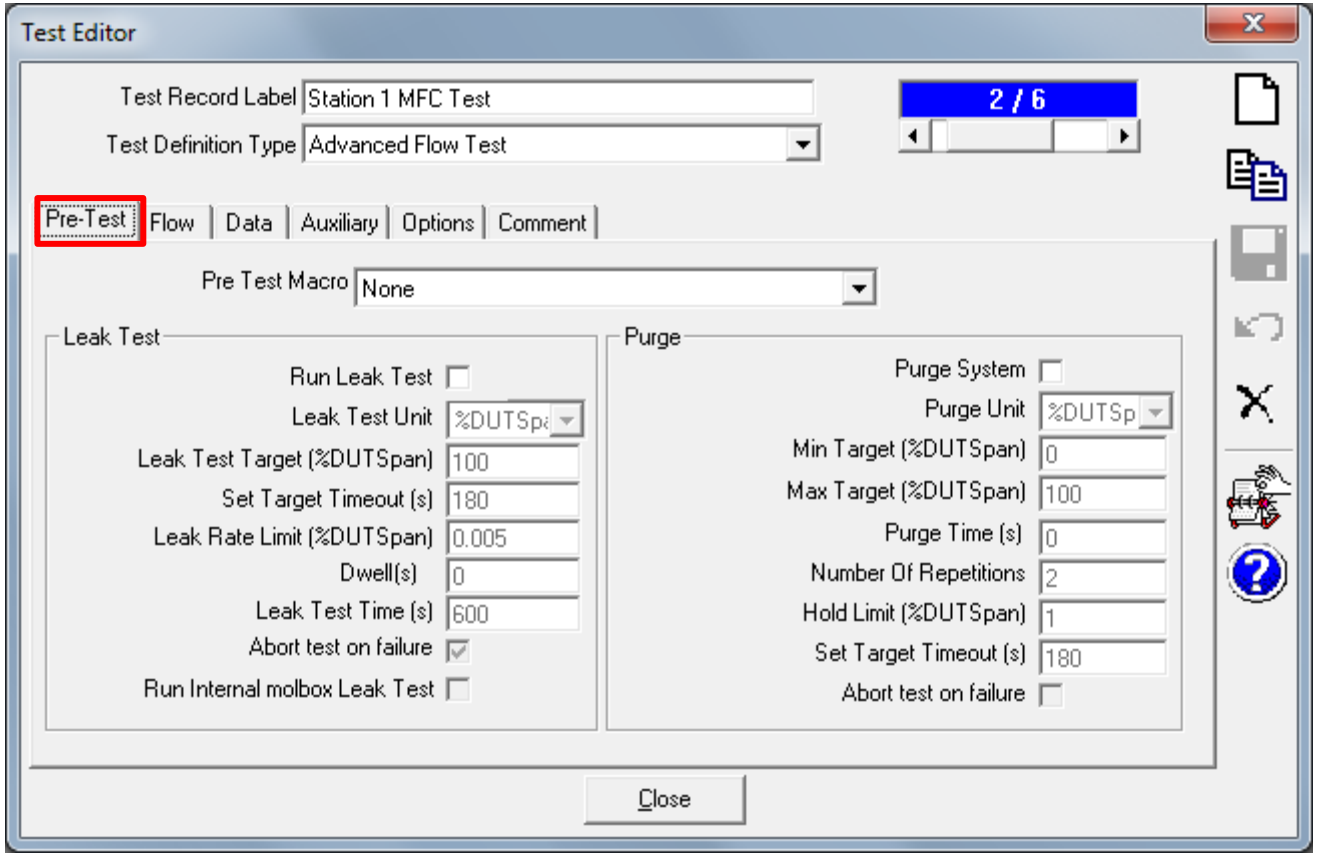
Setup devices

- Setup Support Devices (any device that is not a DUT)
  - Reference – Use Autodetect for Fluke Cal devices (don't have to set them up)
  - Controller - Might be same device as DUT (MFC). Very often a "Manual control" device
  - Monitors – Ambient conditions, Aux. pressure, etc.
  - Similar to the DUT setup tabs, they also have a Set (control) tab that is optional
  - Enter for all devices: manufacturer, model, serial number, asset IDs, unit, min/max range, tolerance, raw output(s), final output, remote command(s)
- When finished setting up the support devices, they are saved and you do not need to do this work again

Setup test definitions

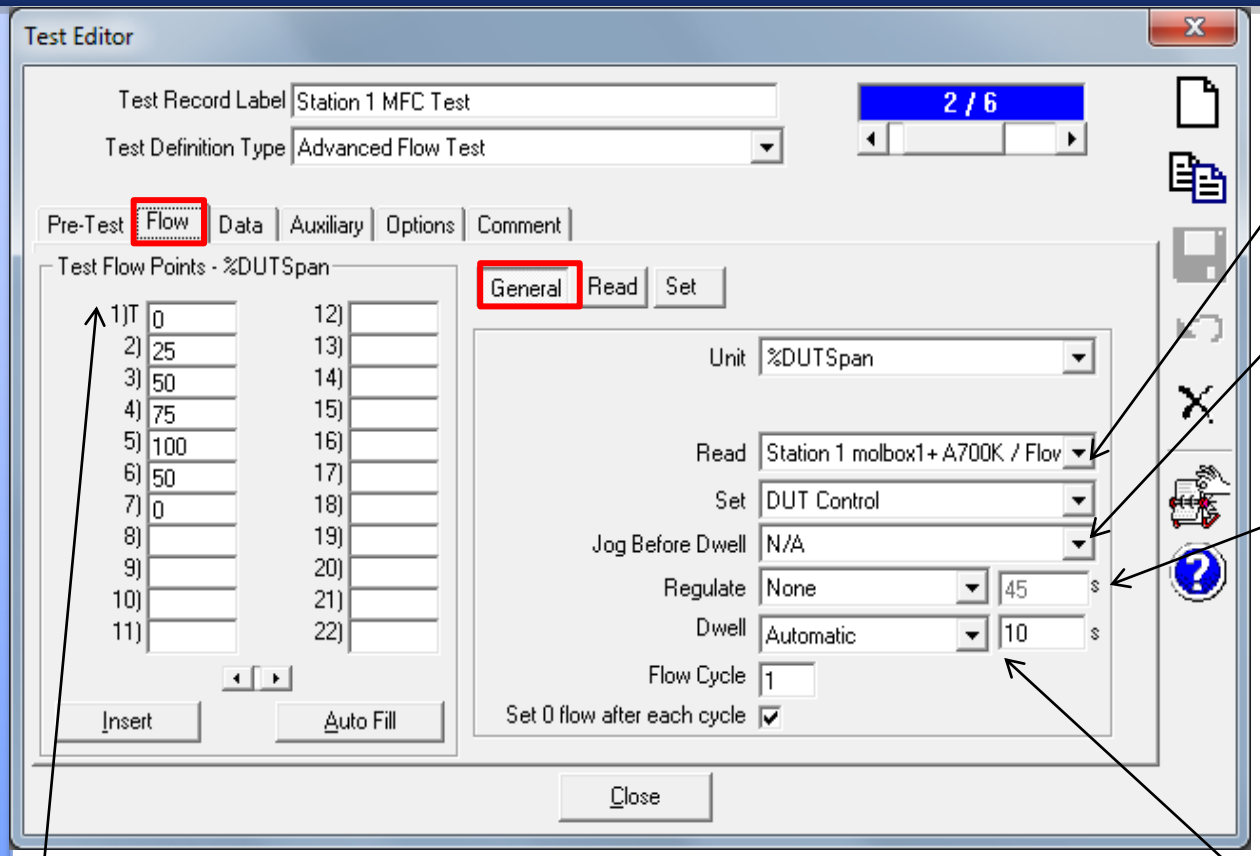
- Setup Test Definitions - specifies how the test will be performed
  - Define setpoints, typically add Tare to first setpoint in test
  - Specify Reference(s), any other Support Devices
  - Ready/not ready criteria (stability, how close to setpoint, for how long)
  - Data collection method (manual or averaging)
  - Specify calibration report template to use (can't do with a Simple Test)
- When finished, the Test Definitions are saved and you do not need to do this work again

Setup test definitions, Pre-Test tab



- **Some prefer to do any Leak Checks and Exercise cycles manually before the test. They are optional**

Setup test definitions, Flow tab



Specify Reference (Read) and Controller (Set)

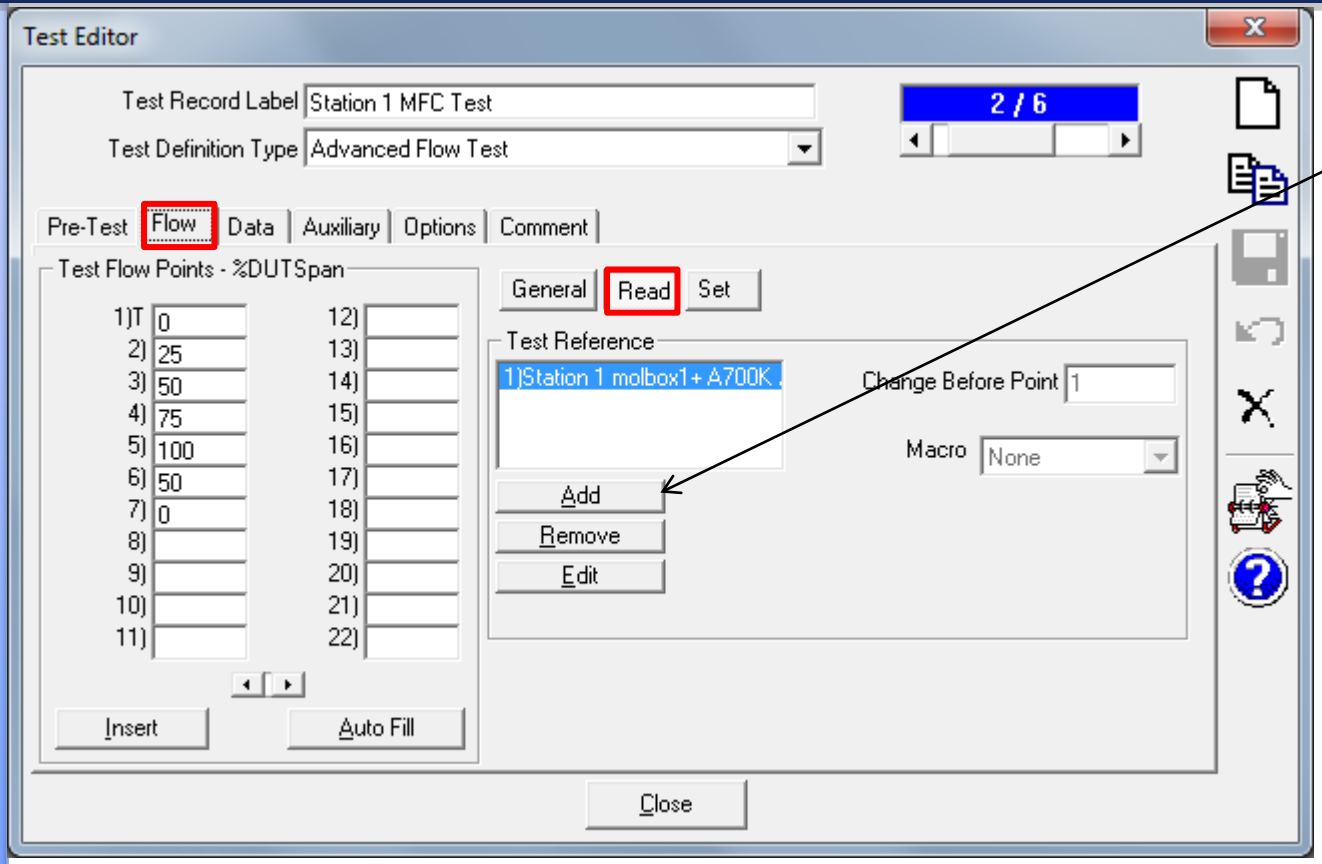
Jog – Adjust flow a little bit before taking data point

Regulate is usually used with digital gauges/meters and you use an automated controller to control to a cardinal point on the DUT. Control is regulated at chosen time intervals

Dwell is wait time before taking data. Automatic 0 is no dwell

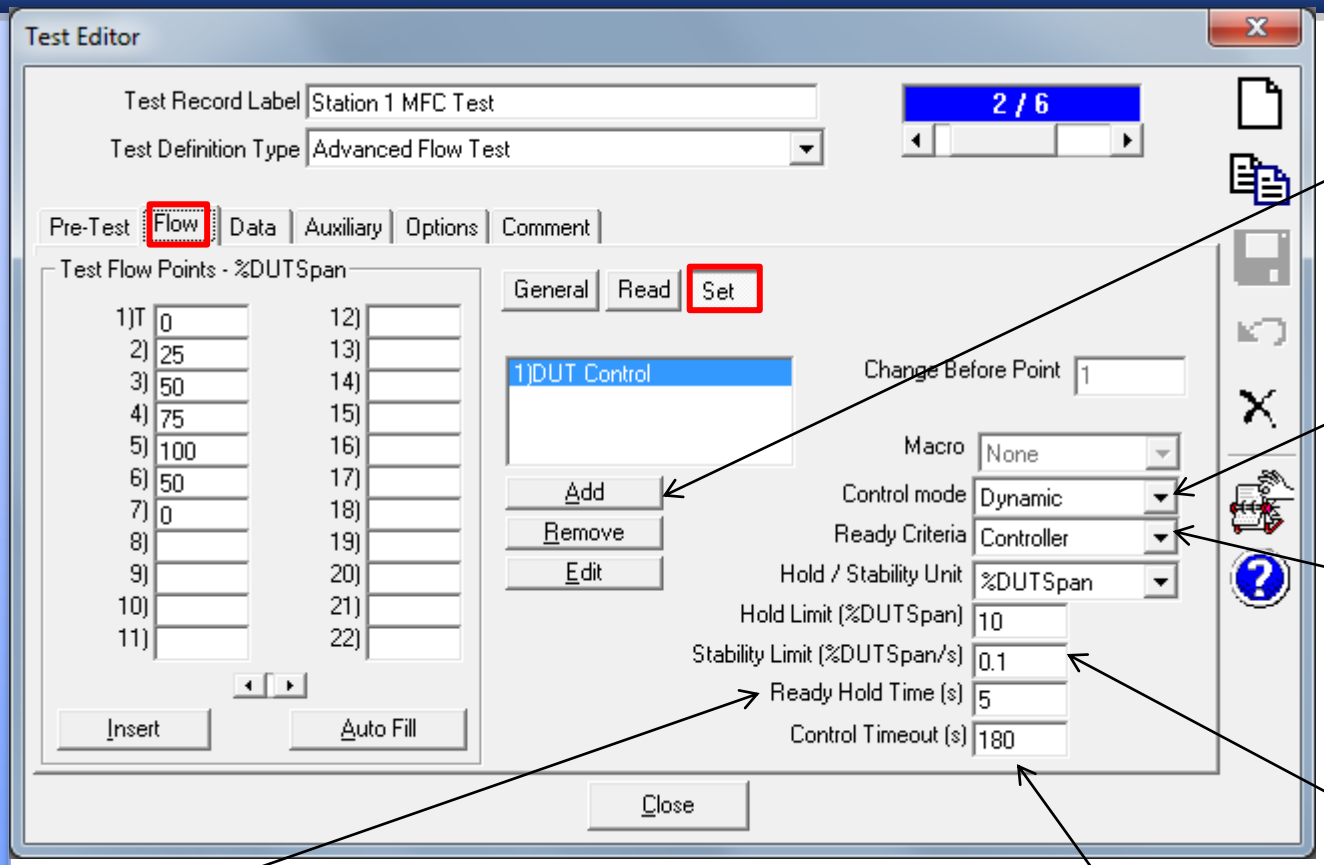
Tare (T) at point 1

Setup test definitions, Read child tab



Add or Edit References, specify what points they are used at (optional). If you do this they will already be selected for the technician, and they won't have to choose them when doing the calibration

Setup test definitions, Set child tab



Add or Edit Set devices (controllers), specify what points they are used at

Control mode doesn't matter with COMPASS for Flow

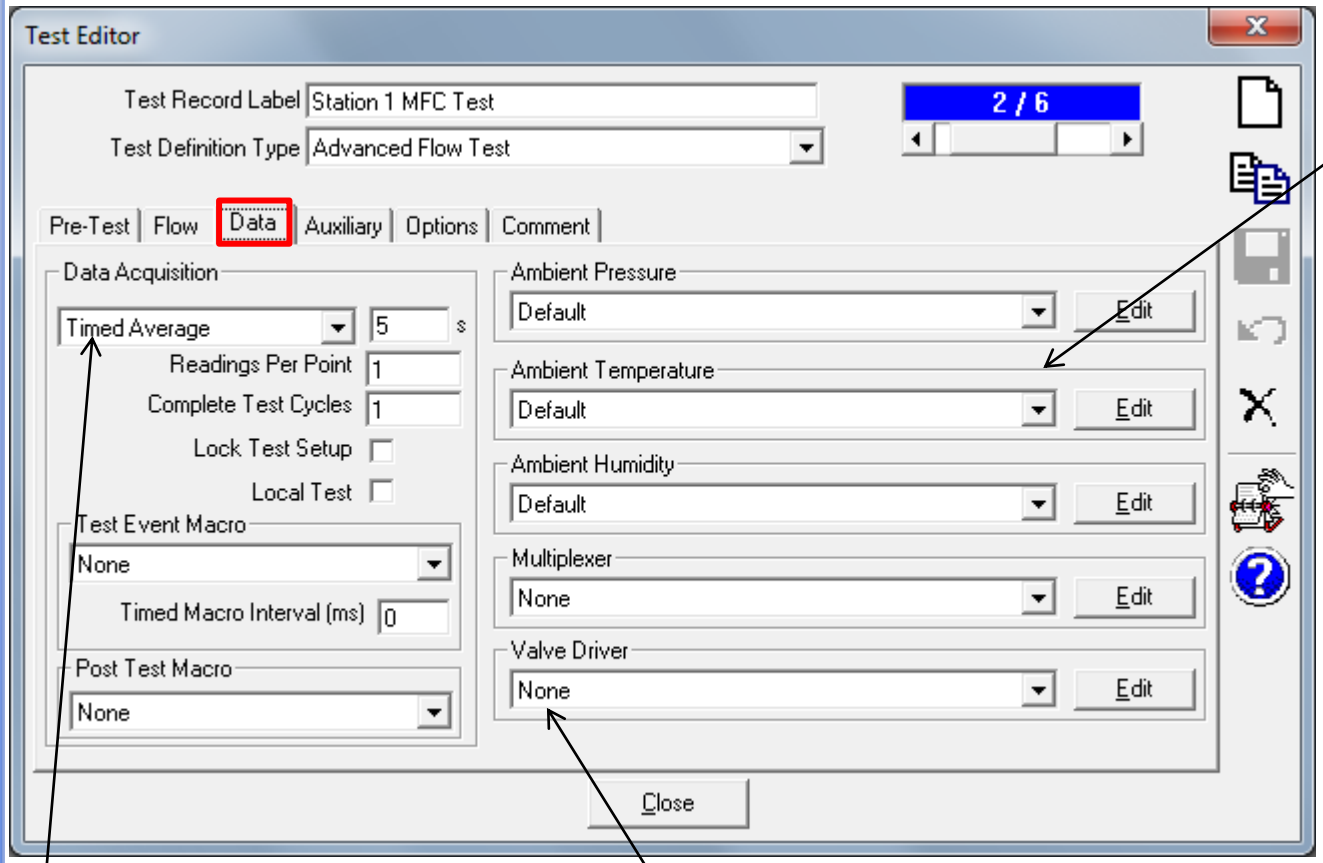
Ready/Not Ready reply from Controller, or COMPASS calculates

Specify ready/not ready criteria. Typically make stability 10 times better than DUT tolerance so control noise and other environmental effects are insignificant

Ready Hold Time – How long to meet ready criteria before continuing on to the dwell time

Control Timeout – How long to get ready. If not, test might be aborted, the point repeated, or a prompt

Setup test definitions, Data tab

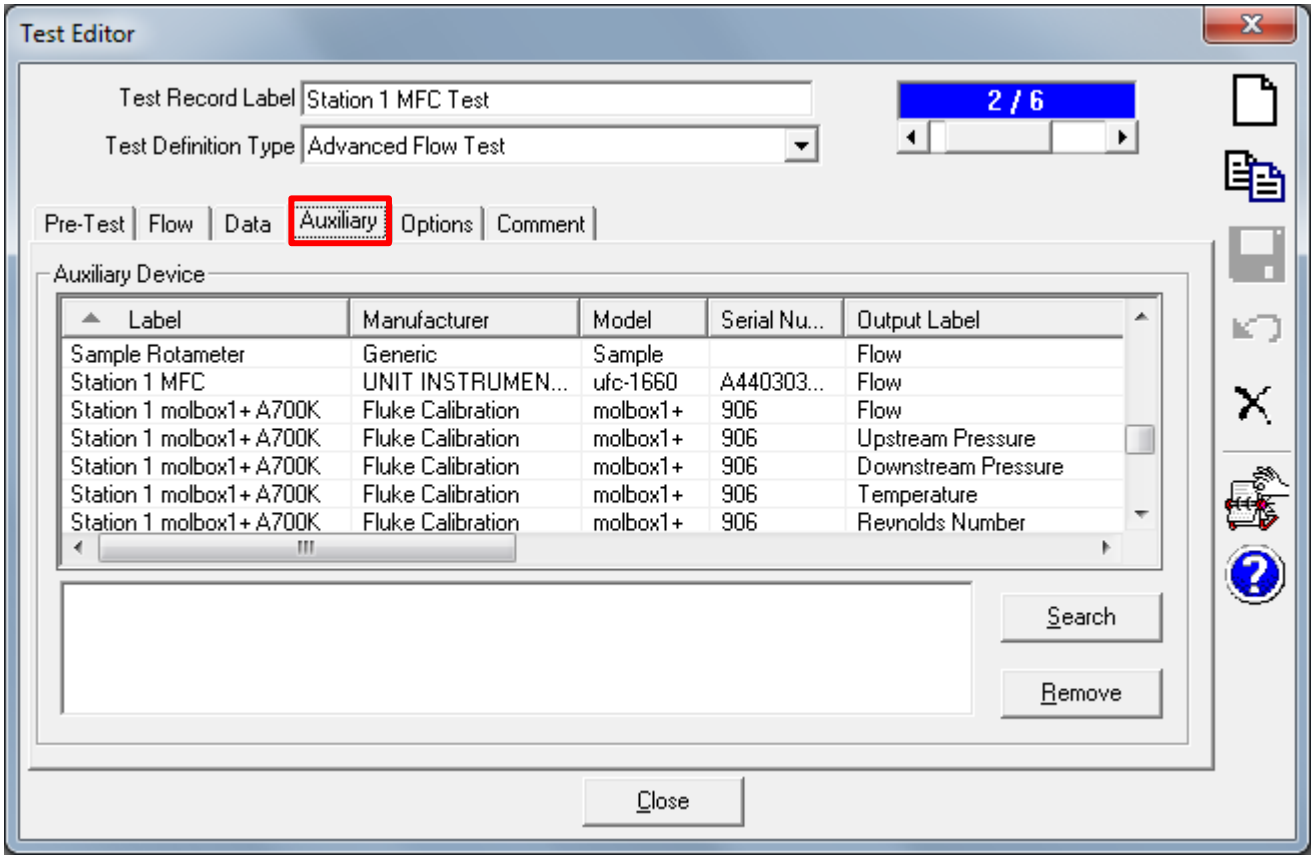


Specify ambient devices (optional)

Timed Average 0 is a single point (no averaging)

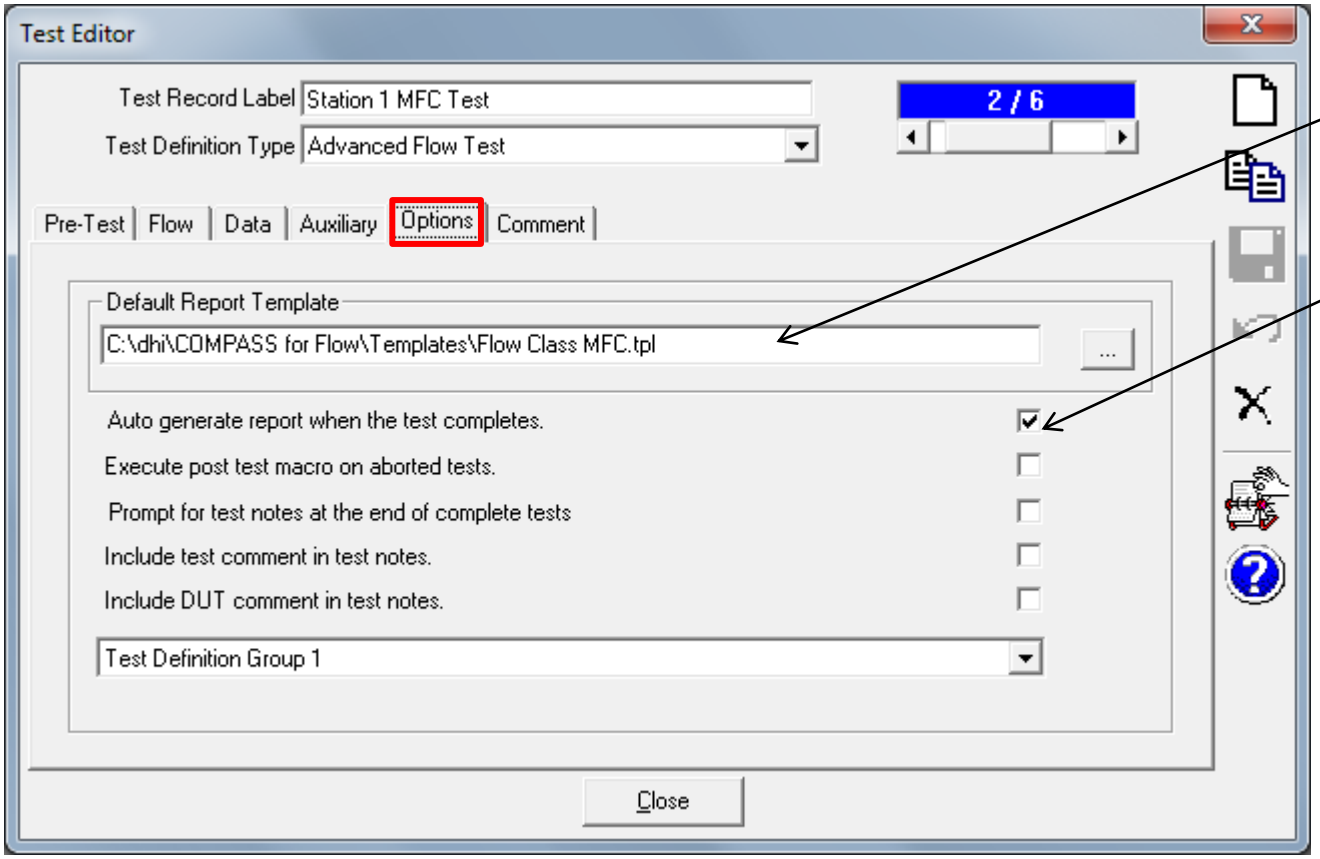
Valve driver(s) might be used to open/close valves, turn on vacuum pump, etc.

Setup test definitions, Auxiliary tab



Choose none or as many Auxiliary devices as you want. For example - extra temperature or pressure sensor, etc.

Setup test definitions, Options tab

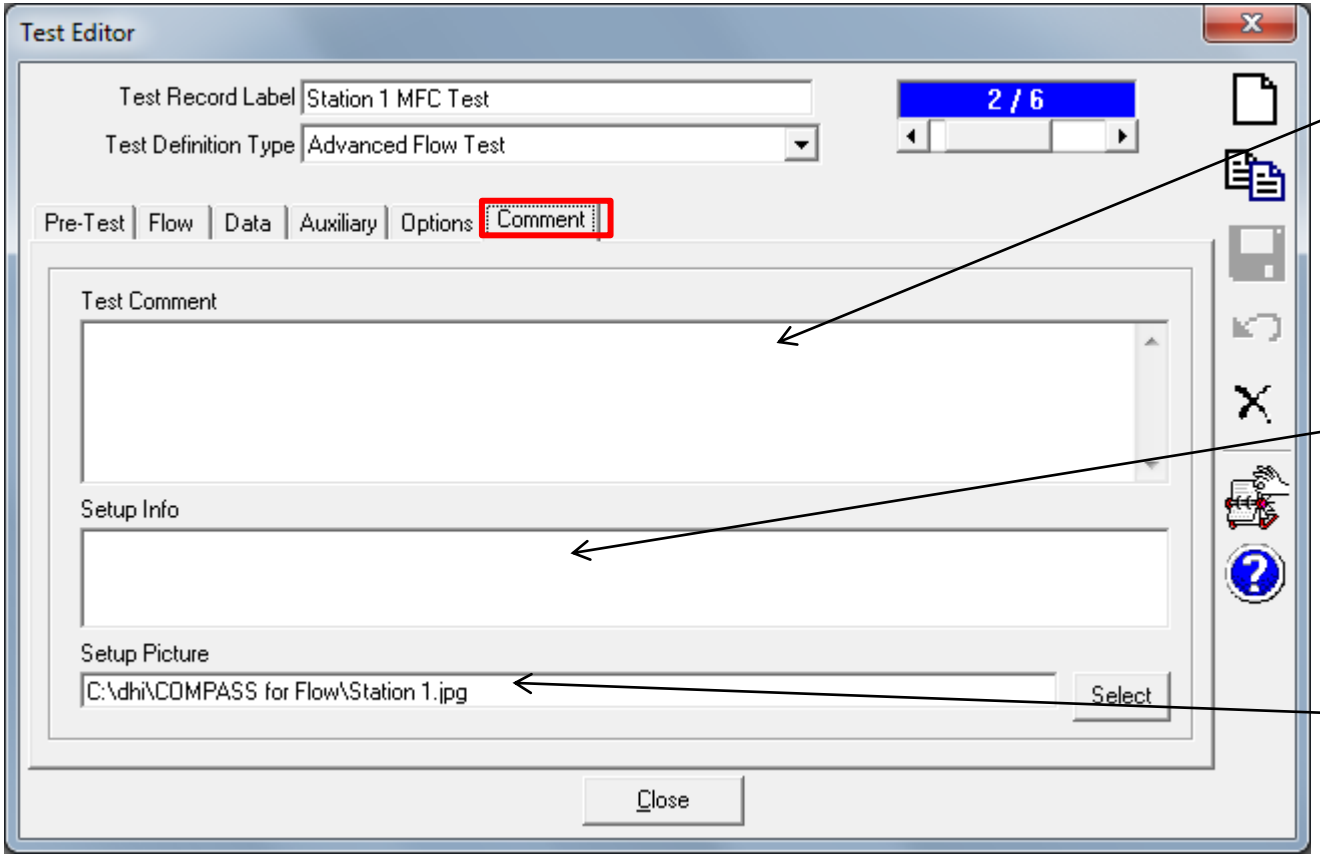


Specify calibration report template

Automatically open calibration report when test is done

Options tab is only in Advanced Tests

Setup test definitions, Comment tab



Comments can be included in data file and calibration report if you want

Setup Info can be read during test initialization

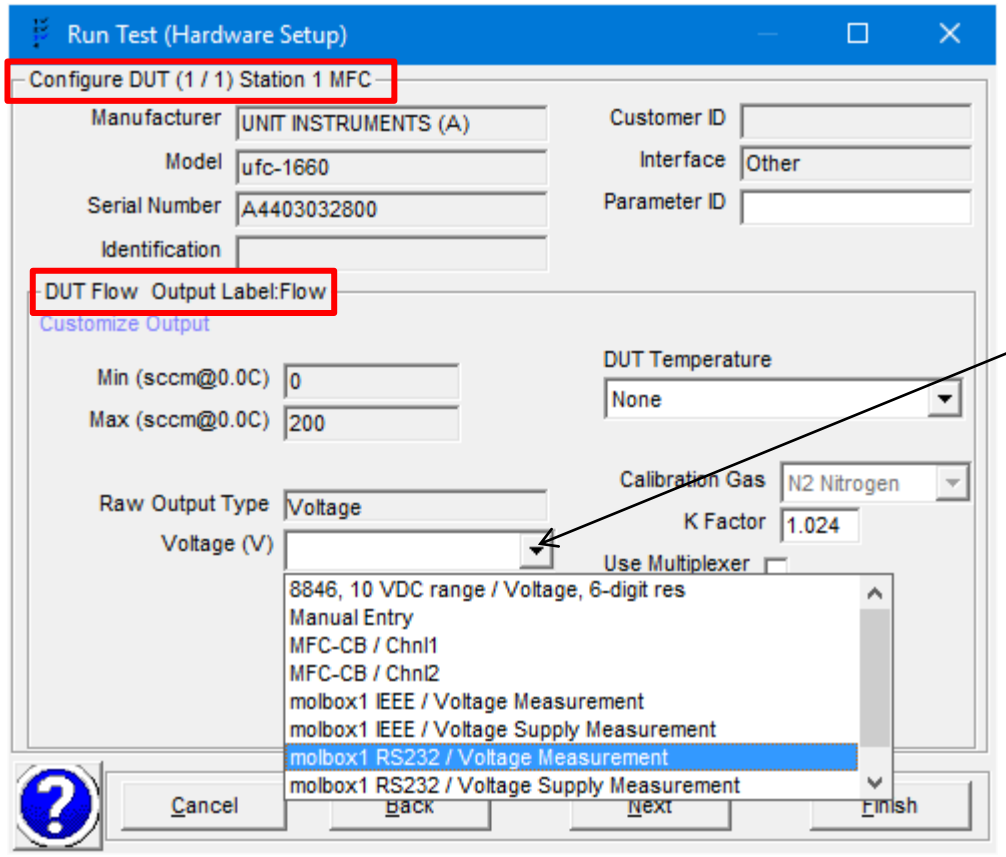
Specify picture that can be shown when initializing test

Run test

Run Test:

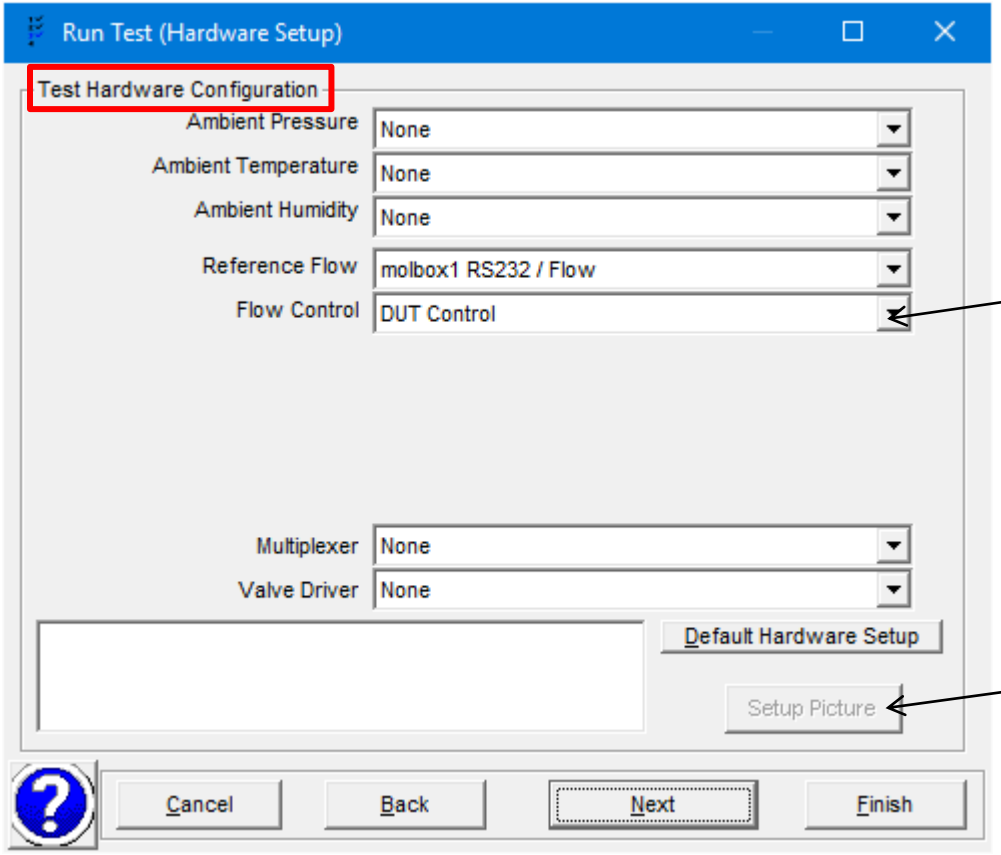
- **Run Test Definition**
  - **Follow the on-screen prompts for selection of DUT(s), Support Devices, and Test Definition**
  - **Proceed through the leak test/purge, test points, collecting data – fully automated, or guiding the user through the test**
  - **Upon completion, the calibration report typically automatically opens in the COMPASS Report Editor**
- **Run Manual Test**
  - **Same but don't choose a test. User selects points and saves data at specified times or intervals. Very good for logging data.**

Run test



Choose molbox1 / Voltage Measurement to read the flow rate from the MFC

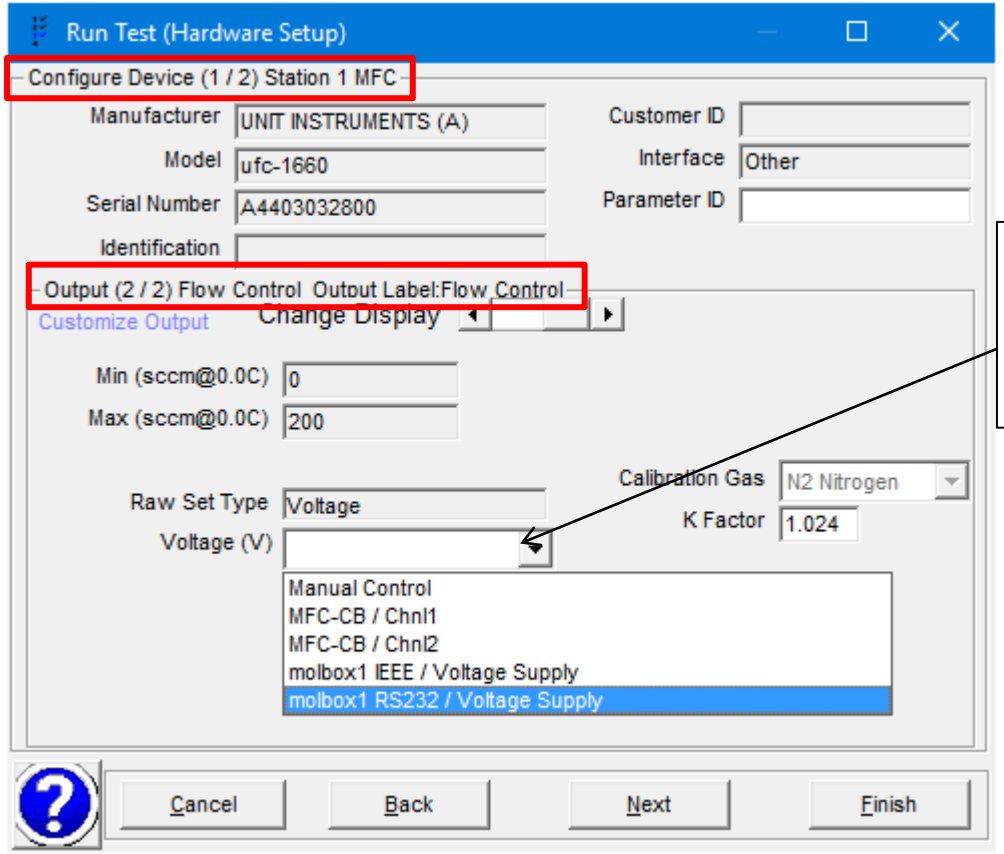
Run test



Choose DUT Control to have the MFC control the flow rates

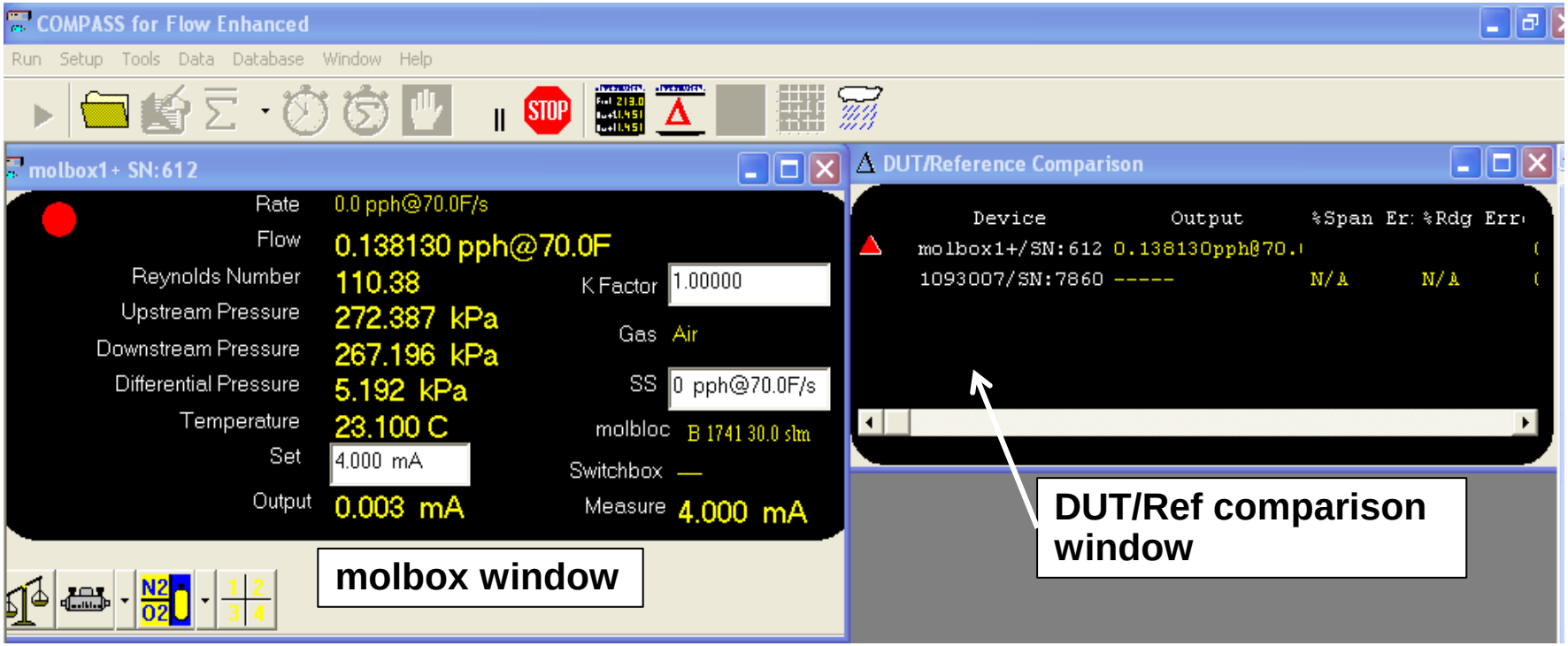
Click [Setup Picture] if you saved a picture in the Test's comments tab.

Run test



Choose molbox1 / Voltage Supply to control the flow rate of the MFC (set the setpoint)

Run test, “Run Window”



Tare
change molbloc
change gas
activate driver(s)

Data, end of test

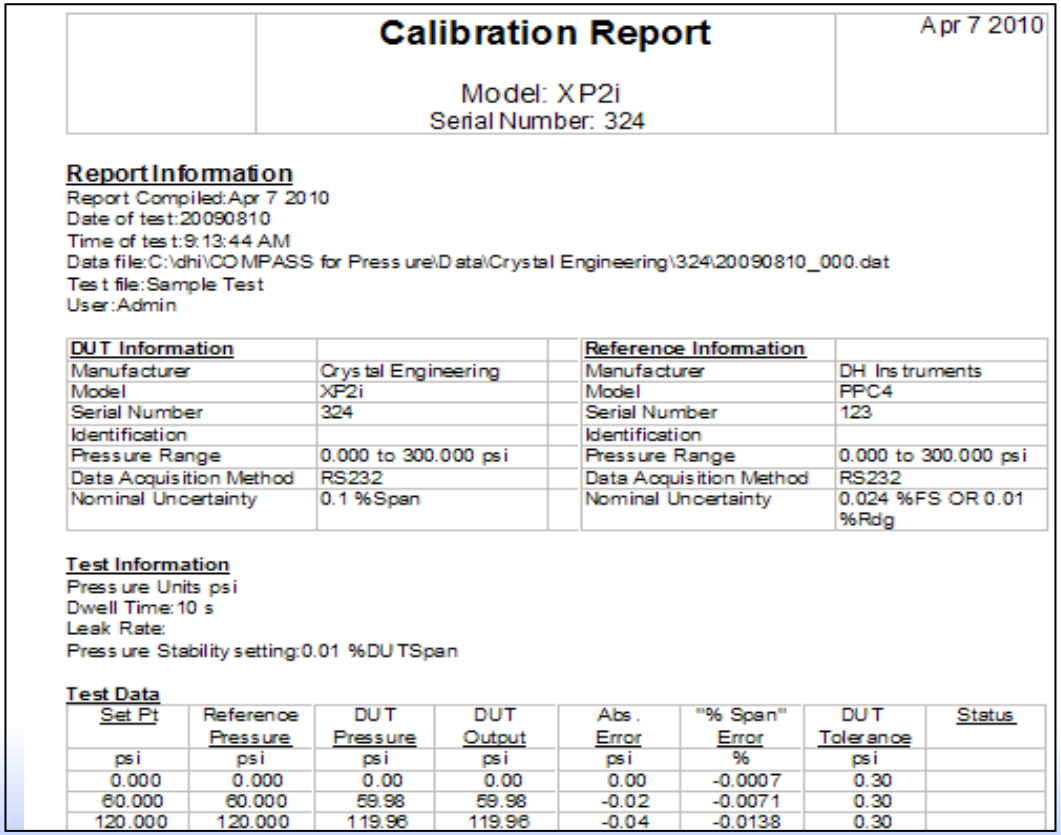
Test data:

- **As COMPASS runs, data is written to a storage location, saved as an ASCII delimited text file**
  - **Storage location is local drive or network location**
  - **Optional, can also save in *.mdb database file**
- **Export to Excel® option, open data file(s) in pre-selected Excel workbook**

Calibration report

COMPASS Report Editor

- **Produces professional quality calibration reports from the data file and a specified template**



Calibration Report

Apr 7 2010

Model: XP2i
Serial Number: 324

Report Information

Report Compiled:Apr 7 2010
Date of test:20090810
Time of test:9:13:44 AM
Data file:C:\dhi\COMPASS for Pressure\Data\Crystal Engineering\324\20090810_000.dat
Test file:Sample Test
User:Admin

DUT Information		Reference Information	
Manufacturer	Crystal Engineering	Manufacturer	DH Instruments
Model	XP2i	Model	PPC4
Serial Number	324	Serial Number	123
Identification		Identification	
Pressure Range	0.000 to 300.000 psi	Pressure Range	0.000 to 300.000 psi
Data Acquisition Method	RS232	Data Acquisition Method	RS232
Nominal Uncertainty	0.1 %Span	Nominal Uncertainty	0.024 %FS OR 0.01 %Rdg

Test Information

Pressure Units psi
Dwell Time:10 s
Leak Rate:
Pressure Stability setting:0.01 %DUTSpan

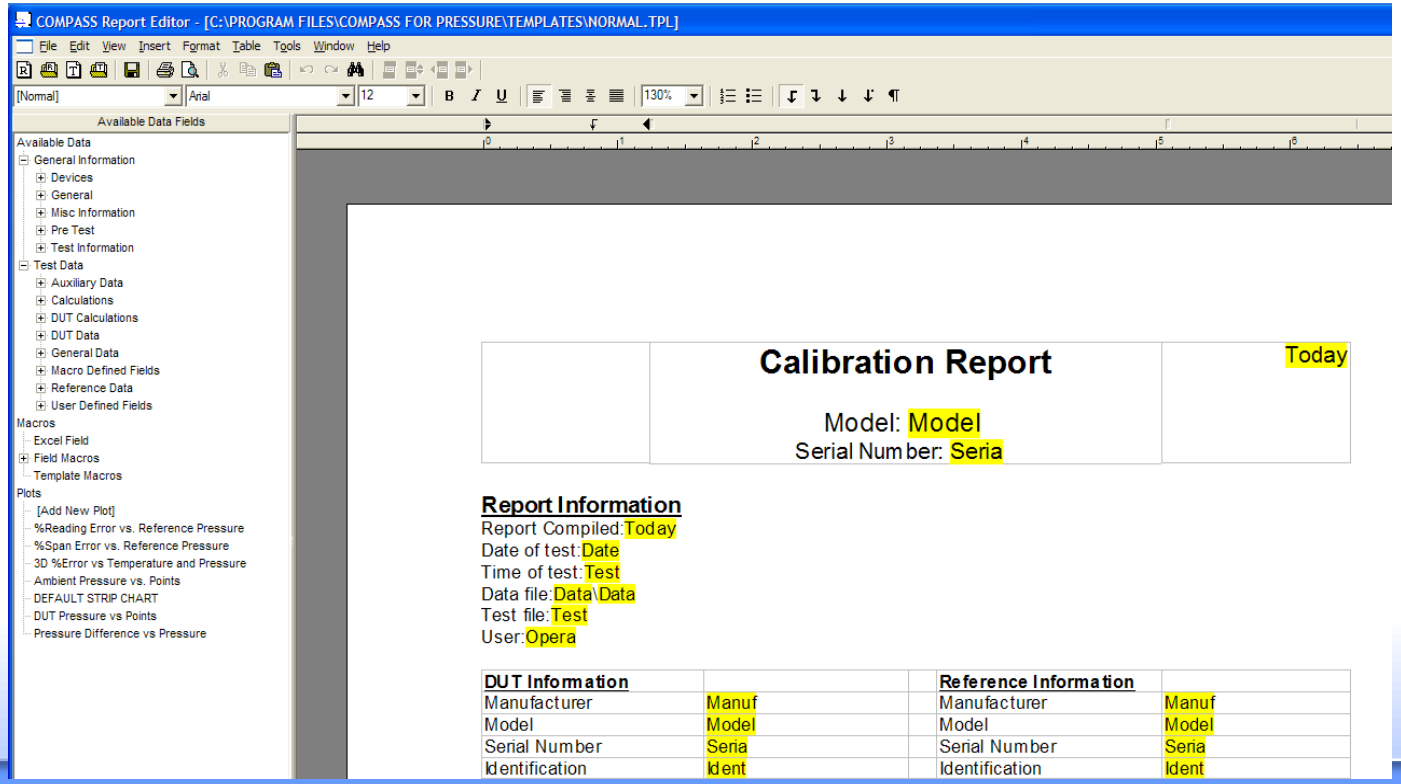
Test Data

Set Pt	Reference Pressure	DUT Pressure	DUT Output	Abs. Error	"% Span" Error	DUT Tolerance	Status
psi	psi	psi	psi	psi	%	psi	
0.000	0.000	0.00	0.00	0.00	-0.0007	0.30	
60.000	60.000	59.98	59.98	-0.02	-0.0071	0.30	
120.000	120.000	119.96	119.96	-0.04	-0.0138	0.30	

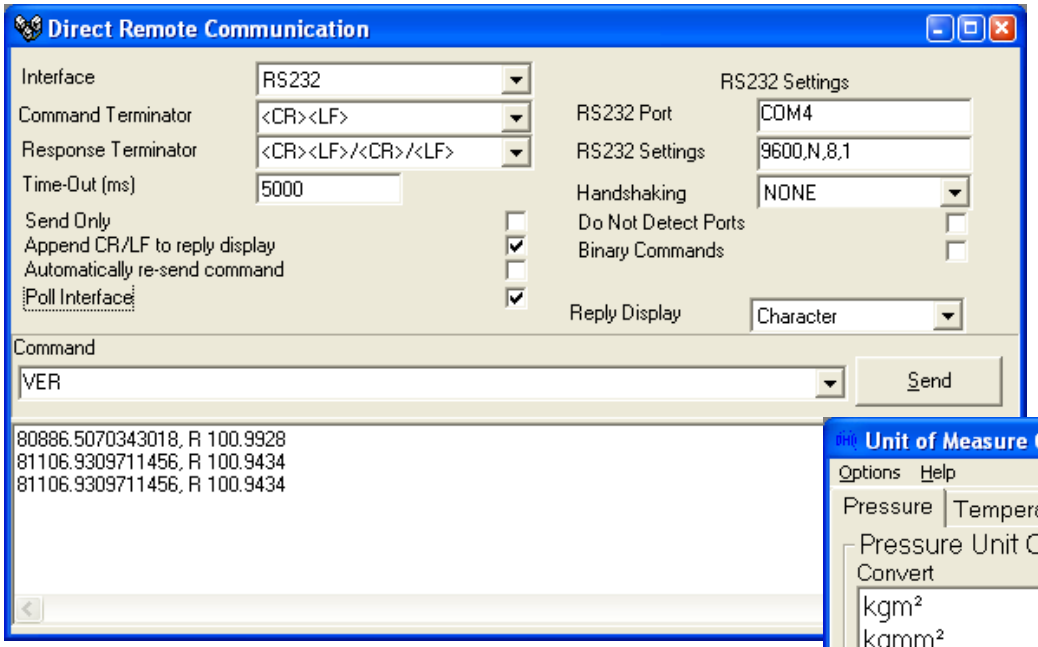
Calibration report customization

Predefined and customizable templates

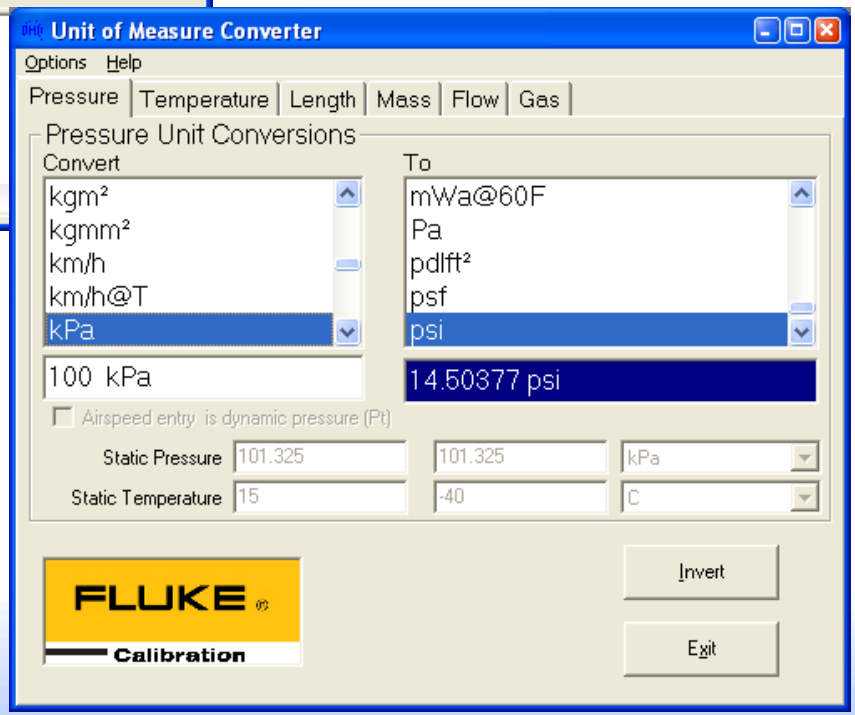
- Black and white is fully editable text
- Data parameters, or calculations, are in yellow and are chosen from field chooser list at left



Remote Comm. / Unit of Measure



Remote Communications Tool - Convenient tool for testing of command syntax and response without running a test. RS232, IEEE, TCP/IP, Hart, etc.

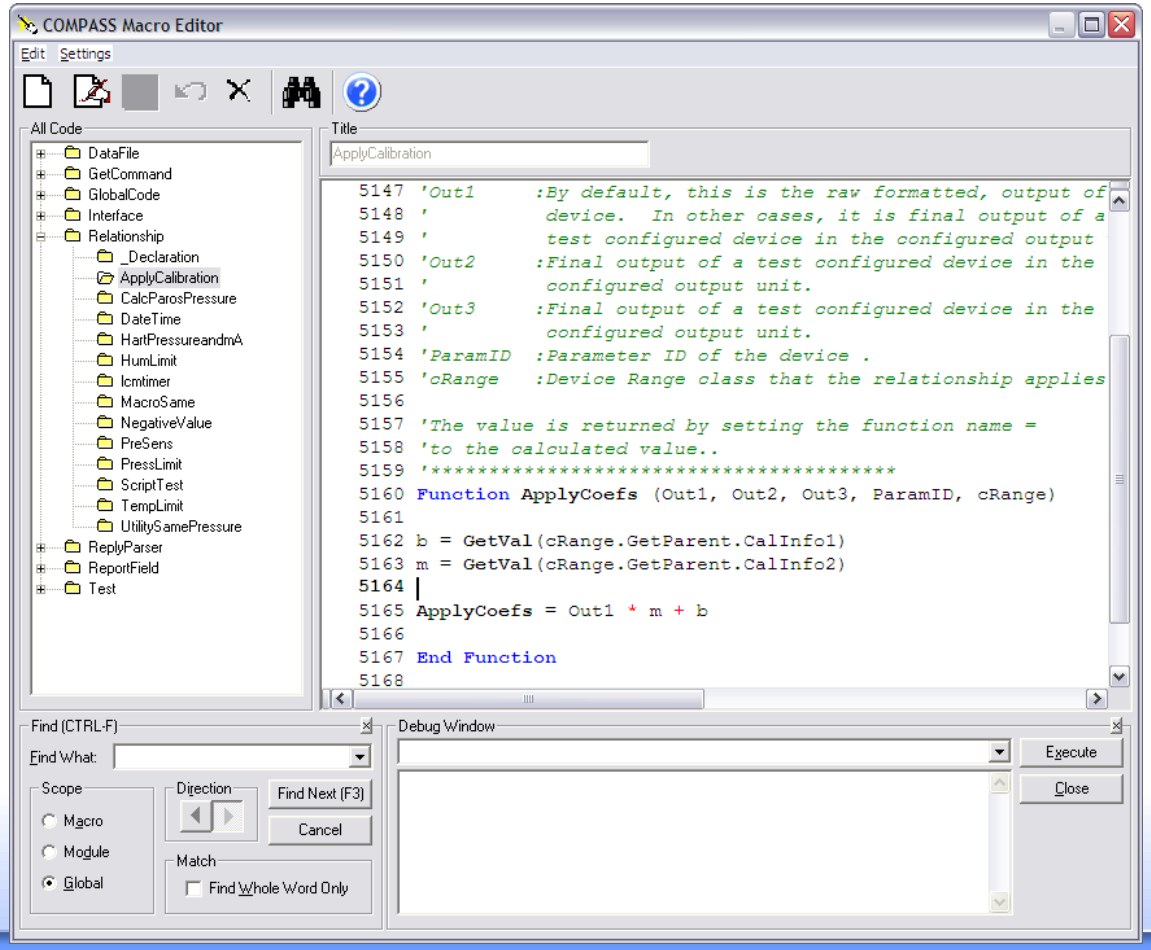


Unit of Measure Converter -

Pressure, Temperature, Length, Distance
Flow, Gas (with density, *viscosity, compressibility*)

Other COMPASS features

COMPASS Macro Editor – VB Script editor for specialized interface, calculations, programming needs



Other COMPASS features

- User and feature display options
  - Hide test initialization windows and options that are not necessary for simple tests. Simplifies the user interface when advanced functions are not required
  - Specify default hardware (power supply, DMM, ambient conditions monitors, etc.)
  - User levels with passwords
  - Network options
  - Seat-based licensing
- Temperature test (has to be with a Flow test)
- Flow test with Line Pressure (e.g. Run at a specified line pressure)

Thank you.

Questions?

Visit the Fluke Calibration website for COMPASS demos, upgrades, and updated example set up database

www.flukecal.com