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Calibration

End-to-End Calibration of 750P Pressure Module

Kyle Clark - Presenter



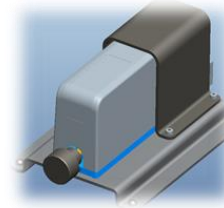
End-to-End Calibration of pressure sensors

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Agenda

- Pressure calibration basics
 - Procedures
 - Equipment
- Automating a pressure calibration
 - Benefits of automating
 - Software
- COMPASS for Pressure calibration software
 - Overview
 - Example setup and calibration, with macros
 - Calibration Report
 - Other COMPASS features
- Questions



End-to-End Calibration of pressure sensors

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Example

- Calibrate a 750P module (750R30, 5000 psi, ± 1.75 psi), with 8270A high pressure modular pressure controller (to 6000 psi)
 - As Found run with data
 - Adjustment
 - Verification run with data

750P Pressure Module



8270A with pressure control module and pressure measurement modules

End-to-End Calibration of pressure sensors

Other Examples of End-to-End tests

Webinar September 2017

Calibrate a PM200 module from a 6270A pressure calibrator in the PMM Calibration Kit with a PPC4 pressure controller.

View the prior Webinar in this Knowledge Base article,
[Macros: PM200 and PM600 - Fully Automated Calibration](#)

What is a pressure calibration?

A comparison by applying known pressure(s) to a pressure measuring Device Under Test (DUT) in order to determine the relationship between the reference device and the DUT

- A test is a set of defined set points
- A single set point could be the test (offset verification/adjustment)
- Adjustment is sometimes done (not always possible)
- A verification is typically done after any adjustment
- A report (or data) is often produced

What is a pressure calibration?

Required components:

- DUT(s) – One or more DUTs of the same range
- Reference pressure device(s)
- Generation and control hardware (sometimes integrated into the reference device)
- Measurement and/or control hardware:
 - DMM, power supply, multiplexor, temperature, humidity, etc.
- Interconnect hardware
- Software and computer if automating the test

Manual or automated test?

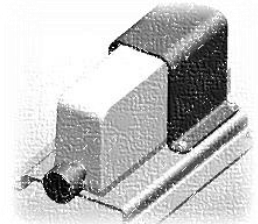
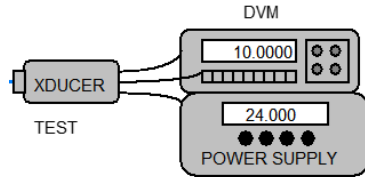
How much can you automate the test?

- Depends on the DUT communications interface (and the reference's)



– RS232, GPIB/IEEE, TCP/IP

– Other device like a DMM



– The DUT's PC software, if it can communicate with your calibration software (COMPASS for Pressure has an example of this in it)

Automated tests

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Benefits of automating a pressure calibration

- Automatic entry and saving of test values (no typo's)
- Long and complicated tests can be accomplished unattended or overnight
- Complex calculations can be done real-time (apply corrections)
- Standardization – The test is run the same intended way every time
- Tests can be duplicated by multiple operators, in multiple locations

Automation software

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COMPASS for Pressure calibration software is PC software designed to assist in the pressure calibration process

- Various levels of automation; manual, semi-automated, fully automated
- More than one DUT – Typically limited only by the data acquisition hardware
- User-scripted test point definitions
- Data saved in unique, write-protected data files
- Calibration report generation tool that is configurable

COMPASS for Pressure

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Configuring COMPASS to run a test

- Setup → DUT
- Setup → Piston Gauge (only if you use piston gauges or deadweight testers)
- Setup → Support Device (any device that is not a DUT, deadweight tester or piston gauge)
- Setup → Test

Setup DUT

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- Enter for all devices
 - Manufacturer, model, serial number, ID (not for profile/generic DUTs)
 - Test to use with the DUT
 - Communication method (manual, RS232, IEEE, other device, etc.)
 - Min/max range, unit, tolerance
 - Remote command(s)
- The entered info can be used during the test, is saved to the data file, and can be shown on calibration reports

Setup DUT

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- Import DUT setup into COMPASS from an existing database
 - Database for 700P/750P is an attachment in the Online Knowledge Base article, [700P & 750P Fluke Pressure Modules - Calibrate with COMPASS for Pressure](#)
 - Note that any DUTs, Tests, Macros with 700P or 750P in their name are updated for 64-bit OS and 700PCK version 4.00. Don't need old flukeinterface.exe file



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Fluke Calibration Help Center / Pressure Calibration / COMPASS for Pressure Calibration Software

700P & 750P Fluke Pressure Modules - Calibrate with COMPASS for Pressure, updated for 64 bit operating systems

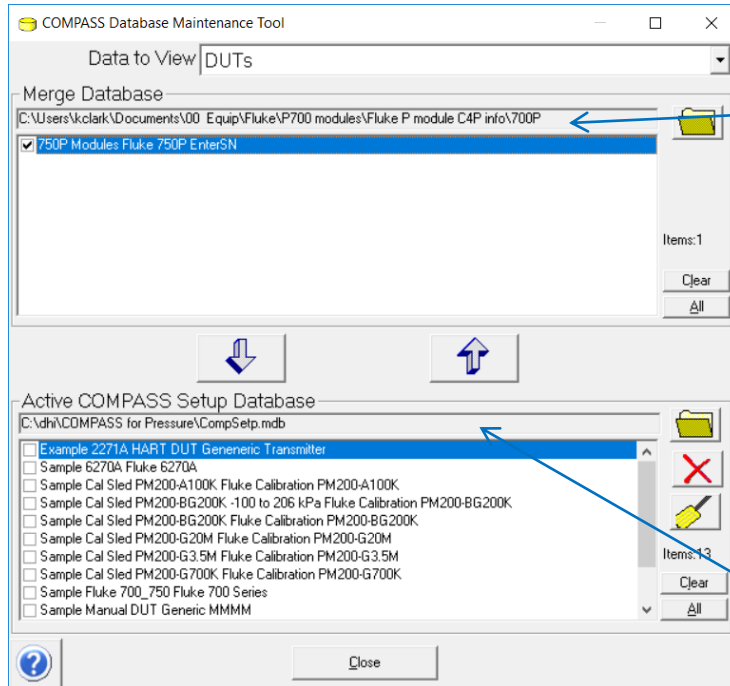



- 700P CompSetp_xfer1.mdb (2 MB)
- Fluke700P_GetPressure Interface Macro 20150922.pdf
- Fluke700P_Zero Test Macro 201504.pdf (200 KB)
- Fluke700P_Adjust Test Macro 201504.pdf (300 KB)
- Fluke700_Cal Unc.tpl (600 KB)
- Fluke700_Cal.tpl (500 KB)

Setup DUT

- Import DUT setup into COMPASS

Menu path; *[Database] → COMPASS Database Maintenance Tool*



1. Select the database to import from by clicking the yellow folder icon. Get this database from 700P/750P Knowledge Base article (previous slide)
2. In “Data to View” window at top, Select “DUTs”
3. Select the 750P Module and/or 700P
4. Press the down arrow icon  to copy the DUT setup to the active database. It automatically copies any needed macros.
5. While here, select “Tests” and copy tests with 750P in their name also. Test macros will also be copied
6. Close this window

Active database

Setup DUT

Header Tab

DUT Editor

Record Label Sample Fluke 700_750 10 / 14

Header Calibration Communications Output Set Comment

DUT Type Advanced DUT {>1 Output}

Record Type Profile

Manufacturer Fluke

Model 700 Series

Serial Number

Identification

Customer ID

Close

Has to be an Advanced DUT to use a macro for communications

Profile – Enter serial number and edit range, model, ID, Cust ID when initializing test

Click the rolodex to see the list of DUTs

Help icon opens the online help file at the applicable section

Setup DUT

Calibration Tab - All cells are optional

DUT Editor

Record Label 10 / 14

Header **Calibration** | Communications | Output | Set | Comment

Calibration Date	<input type="text" value="10/9/2014"/>	Calibration Due Date	<input type="text" value="8/8/2015"/>
Calibration Performed By	<input type="text"/>	Certification ID	<input type="text"/>
Calibration Setting1	<input type="text"/>	Calibration Setting3	<input type="text"/>
Calibration Setting2	<input type="text"/>	Calibration Setting4	<input type="text"/>

Default Test ...

Record Last Edited

Record Last Edited By

Calibration Dates for a Profile DUT don't matter. Will use actual run date as cal. date.

Specify the Default Test so the technician doesn't have to pick it when initializing the test. Can change when initializing test.

Setup DUT

Communications Tab

DUT Editor

Record Label: Sample Fluke 700_750

10 / 14

Header | Calibration | **Communications** | Output | Set | Comment

Interface Common read and set interface.

Data Acquisition Type: Macro

Poll Interval (ms): 500

Command Timeout(s): 8

Command Terminator: <CR><LF>

Response Terminator: <CR><LF>

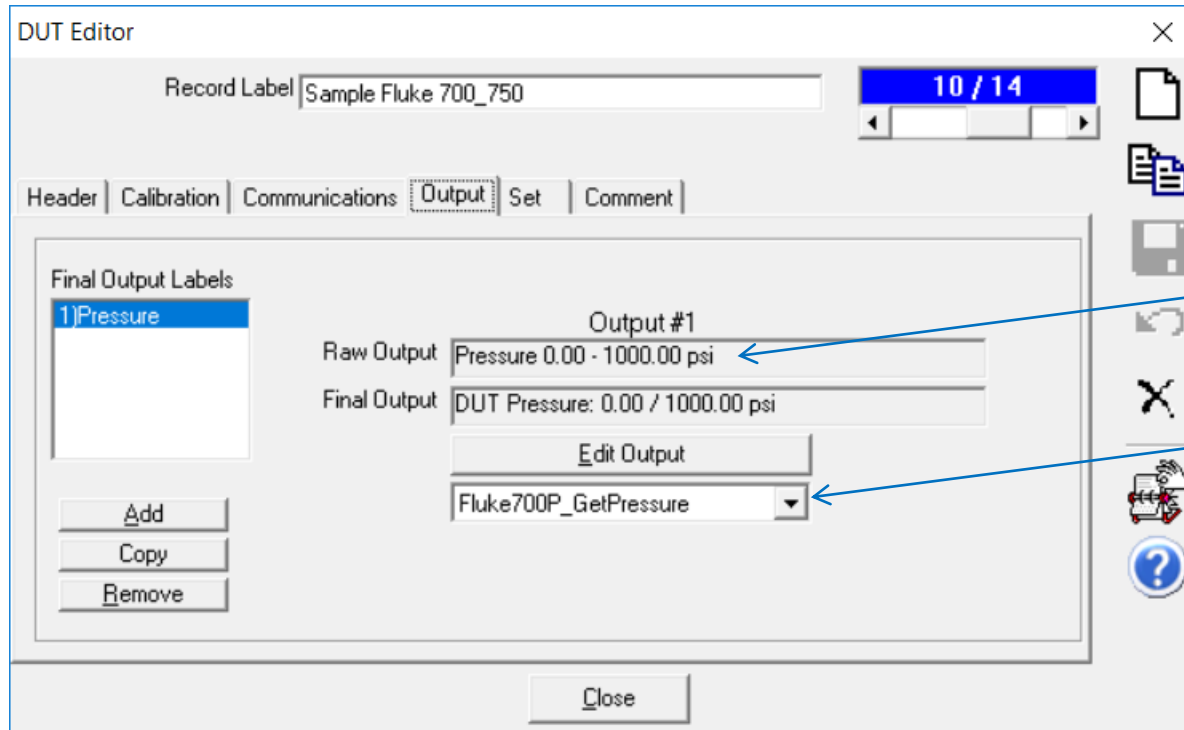
Close

Many communications methods possible. COMPASS uses a macro to communicate to the 750P module through the 700PCK software

- RS232
- HART via RS232
- IEEE 488
- Macro**
- Manual
- Other Device
- RS232
- TCP/IP

Setup DUT (Device Under Test)

Output Tab – Advanced DUT



Will edit the range when initializing the test

The Test Macro to communicate with the module is specified here

Setup DUT (Device Under Test)

Output Tab – Advanced DUT: Raw & Final Outputs are in separate windows

Output Relationship

Raw Output | **Final Output** | Tolerance

Required Raw Outputs to determine Final Output 1

Output Type Pressure psi

Output Source Macro

Minimum 0.00

Maximum 1000.00

Resolution 0.01

Raw Output to Final Output Relationship
Same {Raw Output = Final Output}

OK Cancel

Output Relationship

Raw Output | **Final Output** | Tolerance

Label Pressure

Output Type Pressure

Final Output DUT Pressure

Pressure Measurement Mode Gauge

Unit psi

Minimum 0.00

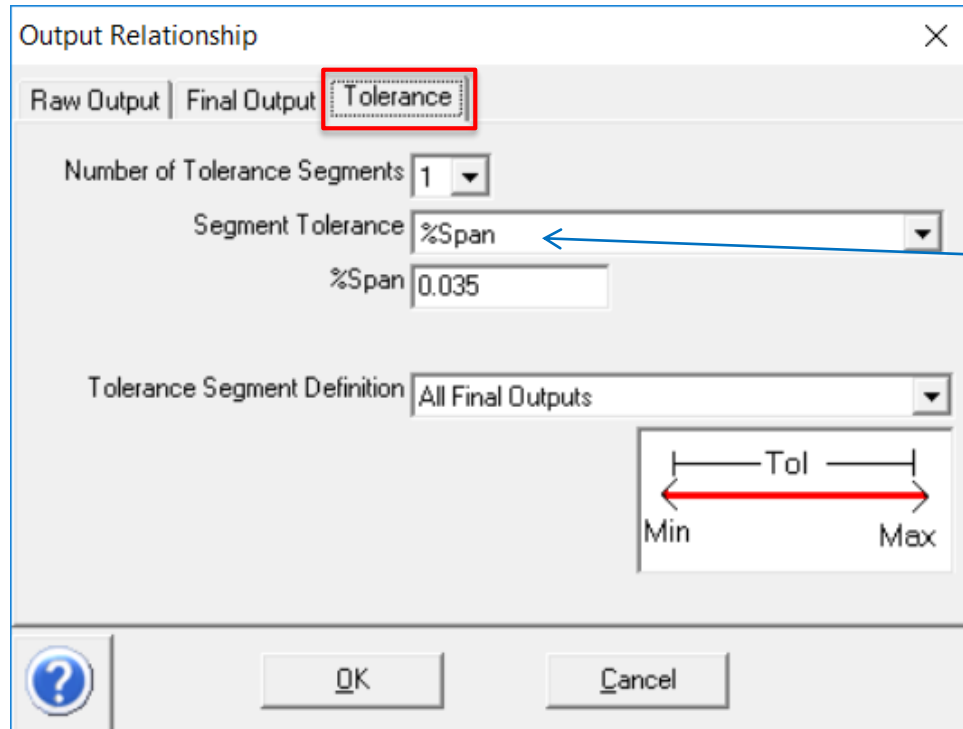
Maximum 1000.00

Resolution 0.01

OK Cancel

Setup DUT (Device Under Test)

Output Tab – Tolerance



Output Relationship

Raw Output | Final Output | **Tolerance**

Number of Tolerance Segments: 1

Segment Tolerance: %Span

%Span: 0.035

Tolerance Segment Definition: All Final Outputs

Min Tol Max

? OK Cancel

Can change tolerance when initializing test for Profile DUTs

Setup Support Devices

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Support Devices are all devices that are not DUTs, piston gauges or deadweight testers

- Setup is the same as DUT (advanced/simple device, read and set outputs, communications)
- Example today uses an 8270A controller



Setup Support Devices

Support Devices

Support Device Editor

Record Label: 8270A 1 / 6

Header | Calibration | Tolerance | Communications | Comment

Support Device Type: Simple Device

Record Type: Individual

Manufacturer: Fluke Calibration

Model: 8270A Autodetect setup

Serial Number: 40212457

Identification: PHX9403

Customer ID: _____

This device can be used as a DUT.

Close



Autodetect works for most Fluke Calibration (and DHI and Ruska devices). With this, you don't have to setup the range, outputs, etc. COMPASS will read during test initialization.

Setup Test

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Pre-Test Tab

Test Editor

Test Record Label: 700P_750P Calibrate AND Adjust

Test Definition Type: Advanced Test

2 / 12

Pre-Test | Pressure | Data | Auxiliary | Options | Comment

Pre Test Macro: Fluke700P_Zero

Leak Test	Exercise
Run Leak Test <input checked="" type="checkbox"/>	System exercise <input type="checkbox"/>
Leak Test Unit: %DUTSp _i	Exercise Unit: %DUTSp _i
Leak Test Target (%DUTSpan): 95	Min Target (%DUTSpan): 0
Set Target Timeout (s): 500	Max Target (%DUTSpan): 100
Leak Rate Limit (%DUTSpan/s): 0.0035	Dwell (s): 10
Dwell(s): 60	Number Of Repetitions: 3
Leak Test Time (s): 30	Hold Limit (%DUTSpan): 0.02
Abort test on failure <input checked="" type="checkbox"/>	Set Target Timeout (s): 180
	Abort test on failure <input type="checkbox"/>

Close

Pre Test Macro to zero the module (through the 700PCK software and hardware)

Exercise Test – Optional, sometimes treat the Leak Test as an Exercise (so don't have to do the Exercise routine)

Leak Test – Typically set "Leak Rate Limit" to 10% of the DUT's tolerance

Setup Test

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Calibration

Pressure Tab – “General” Child tab

Test Editor

Test Record Label: 700P_750P Calibrate AND Adjust 2 / 12

Test Definition Type: Advanced Test

Pre-Test | **Pressure** | Data | Auxiliary | Options | Comment

Test Pressure Points - %DUTSpan

1) 0	12)
2) 20	13)
3) 40	14)
4) 60	15)
5) 80	16)
6) 100	17)
7) 80	18)
8) 60	19)
9) 40	20)
10) 20	21)
11) 0	22)

General | Read | Set

Unit: %DUTSpan

Measurement Mode: Gauge

Read: 8270A / RPT Measurement

Set: 8270A / RPT Control

Jog Before Dwell: N/A

Regulate: None 0 \$

Dwell: Automatic 30 \$

Pressure Cycle: 2

Vent after each cycle:

Insert Auto Fill Close

Unit - Set to %DUT FS for a more universal test

Read - Specify the Reference Device

Set - Specify the Controller

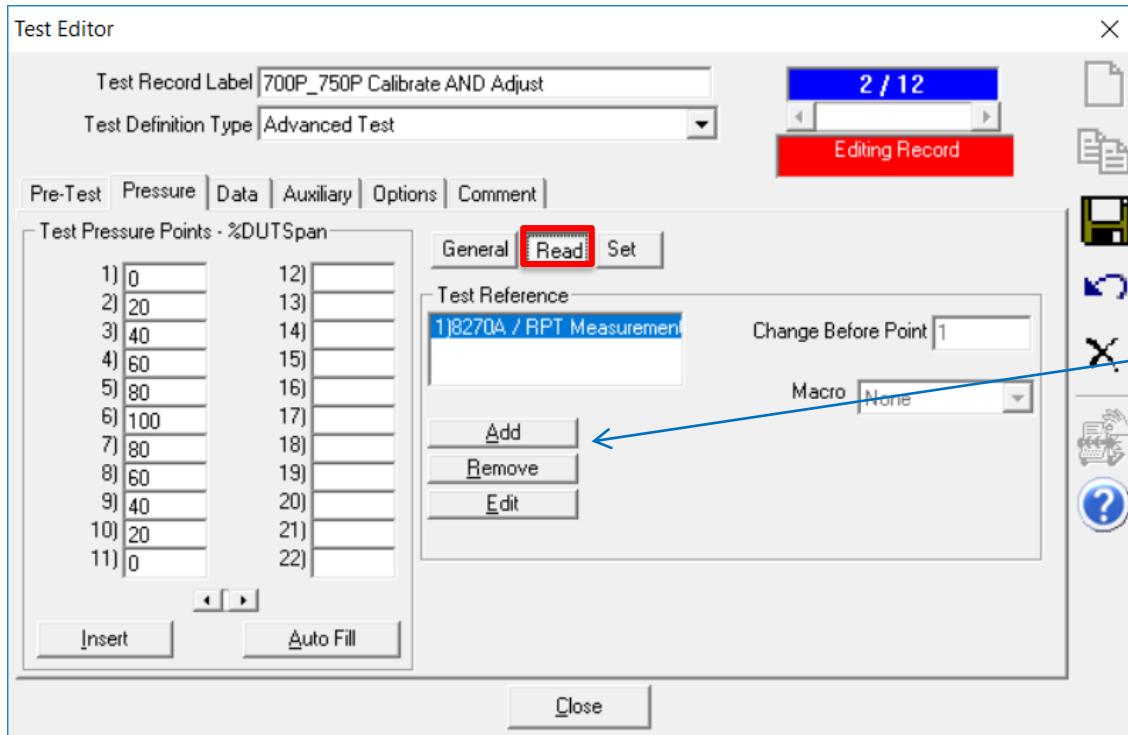
Jog Before Dwell - Typically only for cardinal point calibrations on analog gauges (needle exactly on the mark)

Dwell - Sometimes called “soak” time

Pressure Cycle - 2. first is as-found, second is as-left

Setup Test

Pressure Tab – “Read” Child Tab



The screenshot shows the 'Test Editor' window with the 'Pressure' tab selected. The 'Read' child tab is active, showing a 'Test Reference' field with the value '1)8270A / RPT Measurement'. Below this are 'Add', 'Remove', and 'Edit' buttons. A blue arrow points from a text box to the 'Add' button. The 'Test Reference' field is highlighted in blue. The 'Change Before Point' field is set to '1'. The 'Macro' dropdown is set to 'None'. The 'Test Pressure Points - %DUTSpan' table is visible on the left, with values ranging from 0 to 100. The 'Editing Record' button is visible at the top right.

Test Pressure Points - %DUTSpan	
1) 0	12)
2) 20	13)
3) 40	14)
4) 60	15)
5) 80	16)
6) 100	17)
7) 80	18)
8) 60	19)
9) 40	20)
10) 20	21)
11) 0	22)

Add or Edit References, can specify what points they are used at. We're not doing this. COMPASS will record which module in the 8270A is used for each test point in the data file.

Setup Test

Pressure Tab – “Set” Child Tab

The screenshot shows the 'Test Editor' window with the 'Pressure' tab selected. The 'Test Pressure Points - %DUTSpan' table is on the left, and the 'Set' child tab is active on the right. The 'Set' tab contains the following settings:

Parameter	Value
Test Pressure Control	118270A / RPT Control
Change Before Point	1
Macro	None
Control mode	Dynamic
Ready Criteria	Controller
Hold / Stability Unit	%DUTSpan
Hold Limit (%DUTSpan)	0.0035
Stability Limit (%DUTSpan/s)	0
Ready Hold Time (s)	5
Control Timeout (s)	300

- Get Ready/Not Ready status from **Controller**
- How close to set point to get a Ready condition (in Dynamic mode). Ideally 10% of the DUT tolerance (if possible)
- How stable to get a Ready condition (only for Static mode). Typically 10% of the DUT tolerance (if possible)
- How long to be Ready before going to Dwell
- Timeout to get Ready (continue or abort test)

Setup Test

Data Tab

Enter zero for no averaging

Prevent users from editing tests

If checked test can only run on this PC (must have networked install)

Test Macro – Determines if as-left or as-found and runs the 700PCK Adjust (zero/max) run between. Also calculates per-point measurement uncertainty. Timed interval of zero runs this without any delays

Post Test TestMacro – Close 700PCK interface

Setup Test

Auxiliary Tab – Optional, specify any Aux devices to use

Test Editor

Test Record Label: 700P_750P Calibrate AND Adjust 2 / 12

Test Definition Type: Advanced Test

Pre-Test | Pressure | Data | **Auxiliary** | Options | Comment

Auxiliary Device

Label	Manufacturer	Model
750P Modules	Fluke	750P
8270A	Fluke Calibration	8270A
8270A	Fluke Calibration	8270A
Example 2271A HART DUT	Generic	Transmitter
Manual Device	COMPASS	Manual Device
Manual Device	COMPASS	Manual Device
Manual Device	COMPASS	Manual Device

Search

Remove

Close

Setup Test

Options Tab (only with Advanced Test)

Test Editor

Test Record Label: 700P_750P Calibrate AND Adjust

Test Definition Type: Advanced Test

2 / 12

Pre-Test | Pressure | Data | Auxiliary | Options | Comment

Default Report Template

C:\dhi\COMPASS for Pressure\Templates\Fluke700_Cal Unc.tpl

Auto generate report when the test completes.

Execute post test macro on aborted tests.

Prompt for test notes at the end of complete tests

Include test comment in test notes.

Include DUT comment in test notes.

Test Definition Group 1

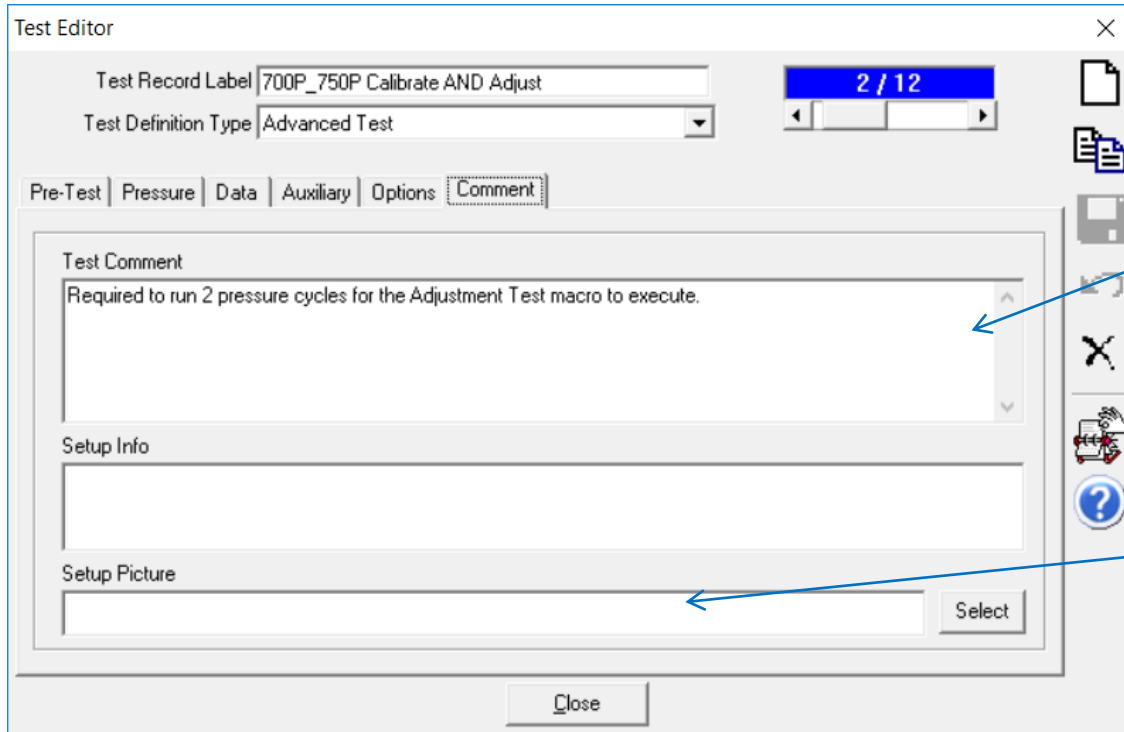
Close

Specify calibration report template. Useful if you have multiple templates. Our example uses a custom As Found – As Left template with measurement uncertainty fields

Automatically open cal report when test is done

Setup Test

Comments Tab – All cells are optional



Can be saved to data file if desired

Technician can view a specified picture when initializing the test

Two options:

Run → [Run Test Definition](#) (video and screen-shots follow)

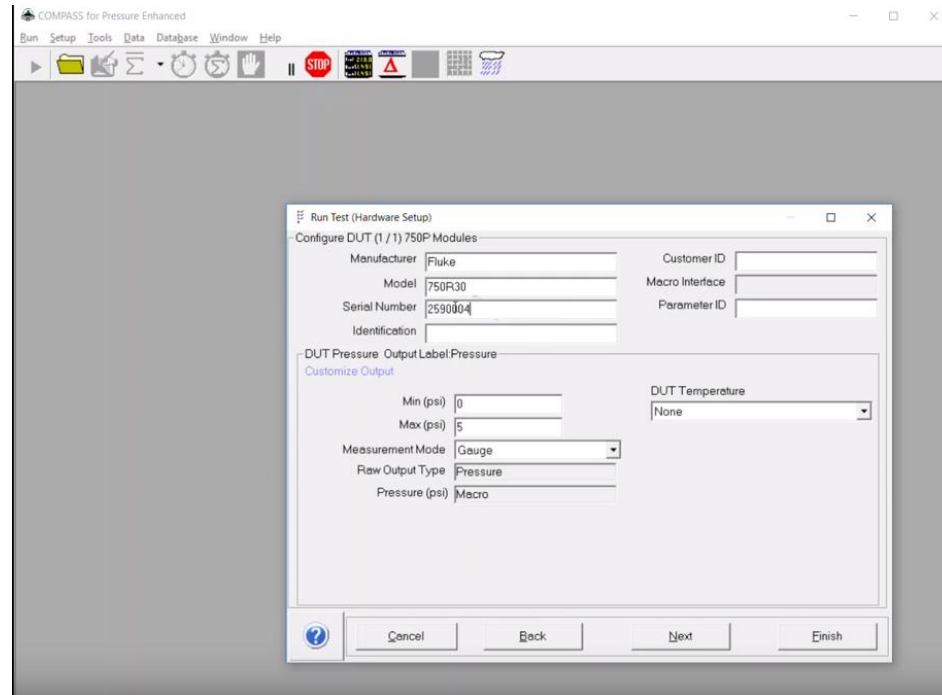
- Initialize Test - Follow the on-screen prompts for selection of DUT(s), the Test and any Support Devices
- Run Test - Proceed through the leak test/exercise, test points, collecting data (might be fully automated)
- End Test - Upon completion, click to create the calibration report in the COMPASS Report Editor (or it might open automatically if configured to do so)

Run → [Run Manual Test](#)

- Same but don't choose a test. User selects points
- Can be good for logging data or troubleshooting COMPASS setups/tests

Initialize Test (Video)

[750P module with COMPASS, Part 1 - Initialize Test \(click to play video\)](#)



Initialize Test – Screenshots (same as video)

Select Units / User

Run Test (Hardware Setup)

Select Units of Measure
The unit lists below define the units of measure to use when logging outputs to the data file. The selections also represent the default display unit of devices that output the corresponding quantity. Select the desired units and press [Next]. The selected Test Definition may override the units selected.

Test Pressure Unit

Temperature Unit

Select/enter user name

Can run test in different units than device and/or test setups

Clear history of the previous run. If you want to run the same exact DUT, test, etc. (you made a mistake the last time) just press the [Finish] button and the same previous test will run

Initialize Test

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Select DUT(s)

Run Test (Hardware Setup)

Select DUT

Add DUTs by double clicking the desired DUTs in the list. Use the [Remove] button to remove DUTs from the support list. The specific setup of DUTs is handled in a later step.

Label	Manufacturer	Model
Sample RPM1	DH Instruments	RPM1
Sample RPM4	DH Instruments	RPM4
Sample Fluke 700_750	Fluke	700 Seri
750P Modules	Fluke	750P
Sample 6270A	Fluke	6270A

750P Modules / Pressure

Search

Remove

Cancel Back Next Finish

List of available DUTs. Double-click to select (then shows in bottom window). Double-click a profile DUT more than once and COMPASS will prompt you for how many

Enter Number of Devices

The device you are adding is a profile. How many devices do you wish to include?

OK

Cancel

2

Selected DUT, 750P Module

Initialize Test

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Configure DUT(s)

Run Test (Hardware Setup)

Configure DUT (1 / 1) 750P Modules

Manufacturer: Fluke

Model: 750P

Serial Number: EnterSN

Identification:

Customer ID:

Macro Interface:

Parameter ID:

DUT Pressure Output Label: Pressure

[Customize Output](#)

Min (psi): 0

Max (psi): 5

Measurement Mode: Gauge

Raw Output Type: Pressure

Pressure (psi): Macro

DUT Temperature: None

Buttons: ? Cancel Back Next Finish

Have to enter Serial Number, Identification or Customer ID for any Profile DUTs now

Click "Customize Output" link to change the range, resolution, tolerance of a Profile DUT if desired

Initialize Test

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Configure DUT(s)

Run Test (Hardware Setup)

Configure DUT (1 / 1) 750P Modules

Manufacturer: Fluke

Model: 750P

Serial Number: EnterSN

Identification:

Customer ID:

Macro Interface:

Parameter ID:

DUT Pressure Output Label: Pressure

[Customize Output](#)

Min (psi): 0

Max (psi): 5

Measurement Mode: Gauge

Raw Output Type: Pressure

Pressure (psi): Macro

DUT Temperature: None

Buttons: ? Cancel Back Next Finish

Have to enter Serial Number, Identification or Customer ID for any Profile DUTs now

Click "Customize Output" link to change the range, resolution, tolerance of a Profile DUT if desired

Initialize Test

Configure DUT(s) – After editing the Output

The screenshot shows a software window titled "Run Test (Hardware Setup)" with a sub-header "Configure DUT (1 / 1) 750P Modules". The window contains several input fields and dropdown menus. The "Serial Number" field is highlighted with a blue arrow pointing to the value "4012457". Another blue arrow points to the "Max (psi)" field, which contains the value "5000". A third blue arrow points to the "DUT Temperature" dropdown menu, which is currently set to "None". At the bottom of the window, there are four buttons: "Cancel", "Back", "Next", and "Finish". A help icon (a question mark in a circle) is located in the bottom-left corner of the window.

Manufacturer	Fluke	Customer ID	
Model	750P	Macro Interface	
Serial Number	4012457	Parameter ID	
Identification			

DUT Pressure Output Label: Pressure	
Customize Output	
Min (psi)	0
Max (psi)	5000
Measurement Mode	Gauge
Raw Output Type	Pressure
Pressure (psi)	Macro
DUT Temperature	None

Changed serial number, range, resolution, tolerance

Initialize Test

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Select Test

Run Test (Hardware Setup)

Select Test Definition
Select the desired Test Definition by double clicking the desired test in the list. Only one Test Definition can be used. Use the [Remove] button to delete an undesired selection.

Label	Pressure Cycle	Mech
700P_750P Calibrate (verification) Only	1	Gal
700P_750P Verification Only, Manual Controller	1	Gal
700PA3 CONFIRMATION (verification only Absolute)	1	Abs
AMH PPC Calibration	1	Abs
Sample Test	1	Abs

700P_750P Calibrate AND Adjust

Search
Remove
View

Cancel Back Next Finish

The Test we specified on the "Calibration" tab in the DUT Setup is here. Can change if desired unless the Test is locked

Can view all tabs of the Test here

Initialize Test

Test Hardware Configuration

Devices that we specified in the Test setup populate here. Can change if desired unless the Test is locked

Run Test (Hardware Setup)

Test Hardware Configuration

Ambient Pressure None

Ambient Temperature None

Ambient Humidity None

Reference Pressure 8270A / RPT Measurement

Test Pressure Control 8270A / RPT Control

Reference Temperature None

Temperature Control None

Multiplexer None

Valve Driver None

Default Hardware Setup

Setup Picture

Cancel Back Next Finish

The image specified in the Comments tab in the Test setup shows if you click the [Setup Picture] button

Text from the "Comments" tab in the Test setup (bold and blue to stand out)

Initialize Test

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Select Auxiliary Devices (optional)

Run Test (Hardware Setup)

Select Auxiliary Device

Add devices by double clicking the desired item in the list. Use the [Remove] button to remove an item from the list. The specific setup of the device is handled in a later step.

Label	Manufacturer	Model
Sample Agilent DMM	Agilent	34401
Sample Agilent DMM	Agilent	34401
Sample Agilent DMM	Agilent	34401
Sample Agilent DMM	Agilent	34401
Sample Agilent DMM	Agilent	34401

Search

Remove

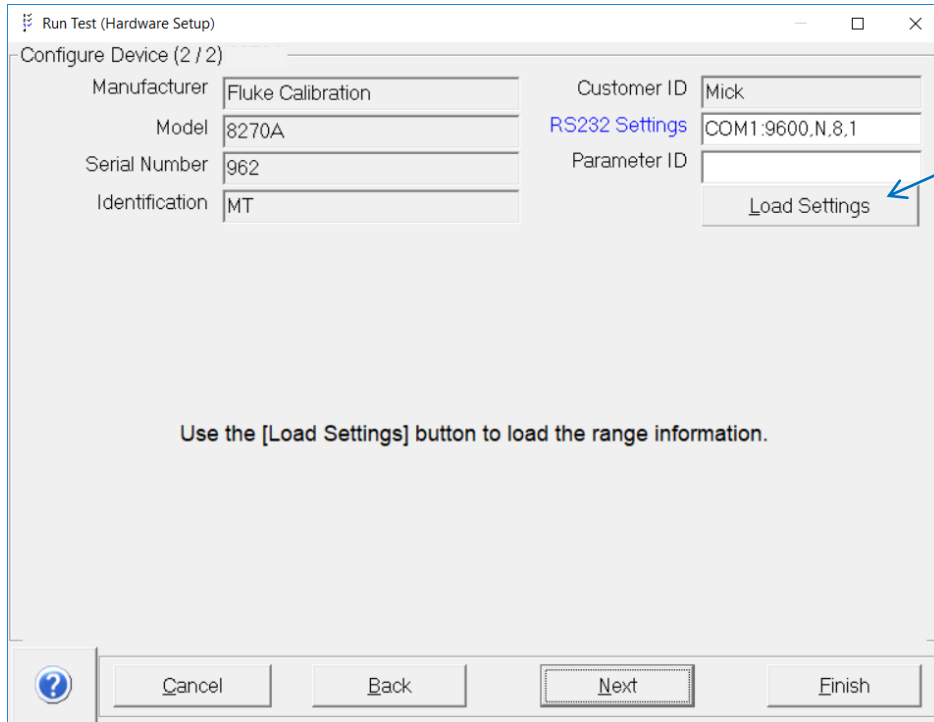
Cancel Back Next Finish

Same selection method as DUTs

You can prevent this screen from showing by this path:
[Tools], <Options>, "Initialize" tab

Initialize Test

Configure/Verify Reference, Controller, Auxiliary Device(s)



Run Test (Hardware Setup)

Configure Device (2 / 2)

Manufacturer	Fluke Calibration	Customer ID	Mick
Model	8270A	RS232 Settings	COM1:9600,N,8,1
Serial Number	962	Parameter ID	
Identification	MT		

[Load Settings](#)

Use the [Load Settings] button to load the range information.

? Cancel Back Next Finish

Press [Load Settings] to have COMPASS query the Autodetect device for range(s), etc.

Initialize Test

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Final Verification / Summary

Run Test (Hardware Setup)

Initialization Complete

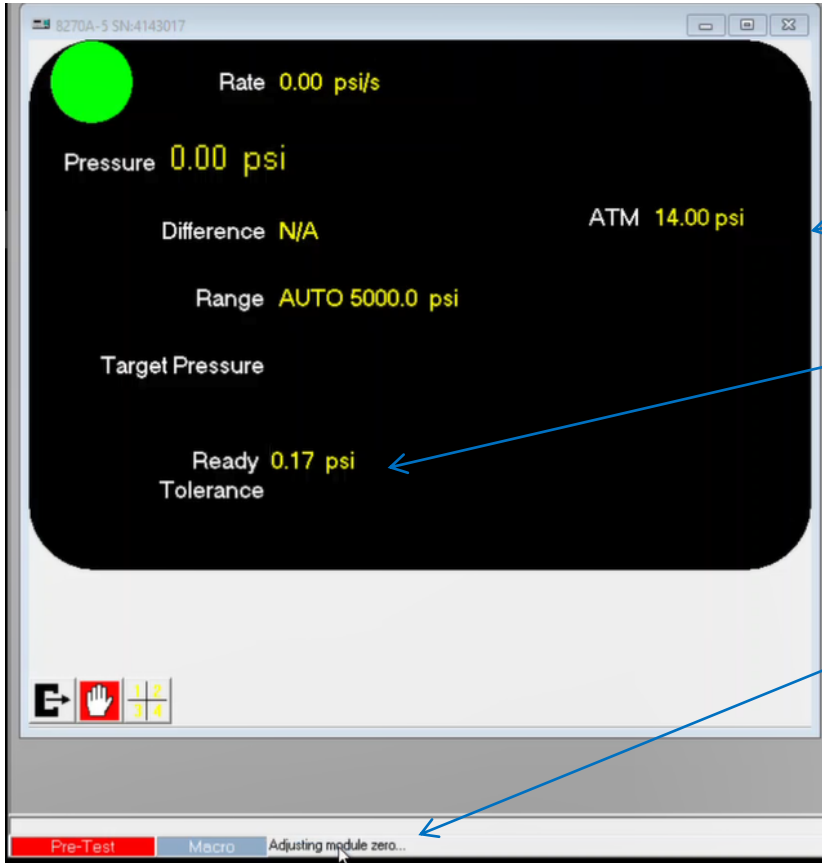
The initialization process is complete. Verify that the remote interface connections and settings are correct for each device. Press [Finish] to begin the test.

Test	PMM Cal Sled Test G2M 0 to 300 psig
DUTs	1 0.000 / 300.000 psi
Reference Pressure	0.000 / 300.000 psi
Temperature	N/A

?

Cancel Back Next Finish

Run Test – Various Run Windows



Autodetect 8270A Window

ATM as setup in the 8270A

Ready Tolerance from Test Setup

Pre-Test Macro shows "Adjusting Module Zero" when module is being zeroed

Run Test – Various Run Windows

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The screenshot shows the COMPASS for Pressure Enhanced! software interface. The main window is titled "DUT/Reference Comparison" and displays a table of test data. Below this, there is a "Data Grid" window showing a detailed view of the test data. The status bar at the bottom indicates "Leak Test" and "Test dwell in progress...".

Device	Output	%Span Error	Tol
PPC3/SN:157	299.999 psi		0.009 psi
PM200-G2M/SN:123456789	300.201 psi	0.101	0.060 psi

Point	DUT Pressure (psi)	DUT Raw Out1 (psi)	Tolerance (psi)	%Span Error (%)	%Rdg Error (%)	Ambient Pressure (kPa)	Ambient Temperature (C)	Ambient Humidity (%RH)

DUT/Reference Comparison Window (can choose fields to show)

Data Grid shows Test Data (configurable, not same as data in data file)

Click Red/Blue status to view more detailed status information

Run Test – As Found Data (screen-shot)

COMPASS run windows

Macro spy (optional) shows uncertainty components, status of macros

The screenshot displays four main windows from the COMPASS software:

- DUT Reference Comparison:** Shows two devices with their respective outputs and tolerances.

Device	Output	%Span Er:	Tol
8270A-5/SN:4143017	4997.45 psi		0.50 psi
-750R30/SN:2590004	4996.04 psi	-0.028	1.75 psi
- Test Data Plot:** A line graph titled "Pressure Difference vs Pressure" showing DUT - Ref (psi) on the y-axis (ranging from -1.5 to 1.5) and Ref Pressure (psi) on the x-axis (ranging from 0 to 3500). The plot shows a relatively flat line around 0 psi difference.
- Macro spy:** A log window showing test results for Cal700P_Unc. It lists multiple test entries with timestamps (20180527 18:11:54) and various parameters like Confidence, k, F, U1, S1, S2, U2, Unc, ExpUnc, DUT-Ref, GB, and Pass/Fail status. A blue arrow points to the top of this window.
- Camera View:** Shows the physical display of the 8270A controller. The display shows "4997.449 psi" and "Setpoint: 5000.000". A blue arrow points to the pressure reading.

At the bottom of the screenshot, there is a data table with the following columns: Point, Set Point (psi), DUT Pressure (psi), Reference Pressure (psi), DUT Error (psi), Tolerance (psi), User Defined, Status, and String. The table contains 5 rows of data, all with a "Pass" status.

Data Plot – Built in plots or make your own

8270A controller display (not in COMPASS)

Run Test – As Found Data (Video)

FLUKE®

Calibration

[750P module with COMPASS, Part 2 - As Found Data \(click here for video\)](#)

The screenshot displays the COMPASS software interface for pressure calibration. The main window shows a 'NIST Reference Comparison' table with the following data:

Device	Output	%Span Err	Tol
8270A-5/SN:4143017	4998.38 psi	0.50	psi
1-750R30/SN:2590004	4997.78 psi	-0.012	1.75 psi

Below the table is a 'Test Data Plot' titled 'Pressure Difference vs Pressure'. The graph shows 'DUT - Ref(psi)' on the y-axis (ranging from -1.5 to 1.5) and 'Ref Pressure(psi)' on the x-axis (ranging from 0 to 3500). The data points are clustered around 0.5 psi difference.

At the bottom, a table lists test results for four points:

Point	Ref. Point (psi)	DUT Pressure (psi)	Reference Pressure (psi)	DUT Error (psi)	Tolerance (psi)	Test Defined?	Status	Rating
1.1	0.00	0.00	0.00	0.00	1.75	1.744	Pass	
1.2	1250.00	1249.88	1250.00	-0.12	1.75	1.743	Pass	
1.3	2500.00	2499.90	2500.00	-0.10	1.75	1.742	Pass	
1.4	3750.00	3749.77	3749.98	-0.21	1.75	1.739	Pass	

On the right, the 'Debug Options' window is open, showing a log of test events. The 'Auto Scroll List' is checked, and 'Log To File' is also checked. The log shows a series of 'Test' events for 'CAL700P_000' with 'PASS' status and 'Confidence = 1'. The final entry shows '1249.77 psi' and '1249.98 psi'.

In the bottom right, a camera view shows the physical device's display. The display shows '4998.267 psi' and 'Setpoint: 5000.000'. The status bar at the top of the device display indicates 'Remote', 'Unlocked', and 'Not Ready'. The device display also shows 'Step Size: 14.504 psi' and 'Auto: 4000.00 psi/s'.

Run Test – Adjustment (screen-shot)

Macro spy window shows that adjustment macro code completed

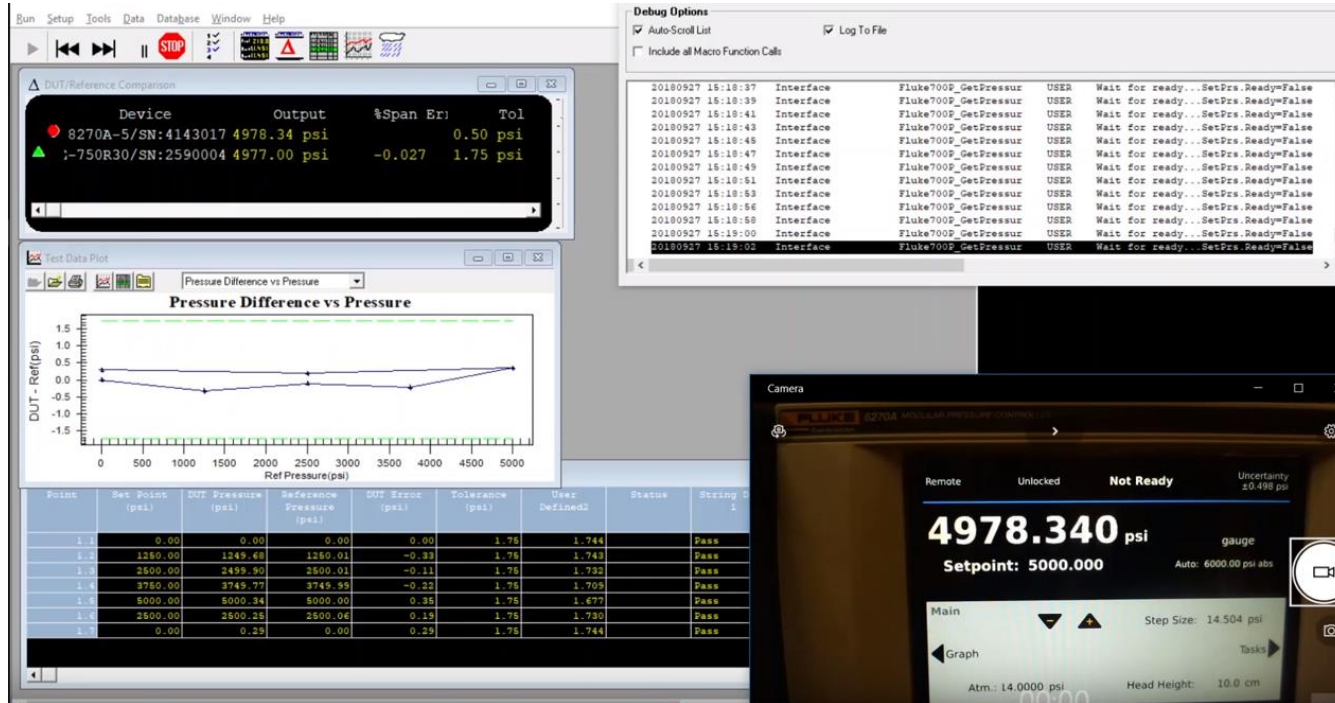
The screenshot displays four windows from a calibration application:

- DUT/Reference Comparison:** Shows two devices with their output and tolerance.

Device	Output	%Span Er:	Tol
8270A-5/SN:4143017	4999.94 psi		0.50 psi
;-750R30/SN:2590004	4999.99 psi	0.001	1.75 psi
- Test Data Plot:** A line graph titled 'Pressure Difference vs Pressure' showing 'DUT - Ref (psi)' on the y-axis (ranging from -1.5 to 1.5) and 'Ref Pressure (psi)' on the x-axis (ranging from 0 to 5000). The data points are clustered around 0.00 psi difference.
- Macro Spy:** A log window showing a series of 'Fluke700P_GetPressur' commands. The final entry at 15:19:52 indicates 'Zero/Span cal Complete'.
- Main Device Display:** Shows the current pressure reading as **4999.949 psi** and the **Setpoint: 5000.000**. The status is 'Ready' and 'Uncertainty ±0.500 psi'.

Run Test – Adjustment (Video)

[750P module with COMPASS, Part 3 – Adjustment \(click here for video\)](#)



The screenshot displays the COMPASS software interface with several windows open:

- DUT/Reference Comparison:** Shows test results for two devices. The first device (8270A-5/SN:4143017) has an output of 4978.34 psi and a tolerance of 0.50 psi. The second device (-750R30/SN:2590004) has an output of 4977.00 psi and a tolerance of 1.75 psi.
- Text Data Plot:** A graph titled "Pressure Difference vs Pressure" showing the difference between the Device Under Test (DUT) and the Reference pressure. The y-axis is labeled "DUT - Ref (psi)" and ranges from -1.5 to 1.5. The x-axis is labeled "Ref Pressure (psi)" and ranges from 0 to 5000. The plot shows a line fluctuating around zero.
- Table:** A table with columns: Point, Set Point (psi), DUT Pressure (psi), Reference Pressure (psi), DUT Error (psi), Tolerance (psi), User Defined, and Status. The status for all points is "Pass".
- Debug Options:** A window showing a log of interface events, including "Fluke700P_GetPressure" and "Wait for ready...SetPrs_Ready=False".
- Camera:** A live video feed of the pressure gauge. The gauge displays a reading of 4978.340 psi and a setpoint of 5000.000. The gauge also shows "Remote", "Unlocked", "Not Ready", and "Uncertainty ±0.498 psi".

Point	Set Point (psi)	DUT Pressure (psi)	Reference Pressure (psi)	DUT Error (psi)	Tolerance (psi)	User Defined	Status
1.1	0.00	0.00	0.00	0.00	1.75	1.744	Pass
1.2	1250.00	1249.68	1250.01	-0.33	1.75	1.743	Pass
1.3	2500.00	2499.90	2500.01	-0.11	1.75	1.732	Pass
1.4	3750.00	3749.77	3749.99	-0.22	1.75	1.709	Pass
1.5	5000.00	5000.34	5000.00	0.35	1.75	1.677	Pass
1.6	2500.00	2500.25	2500.06	0.19	1.75	1.730	Pass
1.7	0.00	0.29	0.00	0.29	1.75	1.744	Pass

Run Test – As Left Data / Verification (Video)



[750P module with COMPASS, Part 4 - As Left Data \(click here for video\)](#)

COMPASS Report Editor - [C:\DHI\COMPASS for Pressure\Data\Fluke\2590004\20180927_001.doc]

File Edit View Insert Format Table Tools Window Help

[Normal] Arial 12 100%

Fluke Calibration
4765 E. Beautiful Lane
Phoenix, AZ 85044

CALIBRATION CERTIFICATE: 2590004-20180927_001.dat

Device Information:		DUT	Reference
Model		FLUKE-750R30	8270A-5
Manufacturer		Fluke	Fluke Calibration
Serial Number		2590004	4143017
Pressure Range		0 000 to 5000 000	
Tolerance		0.035 %FS	

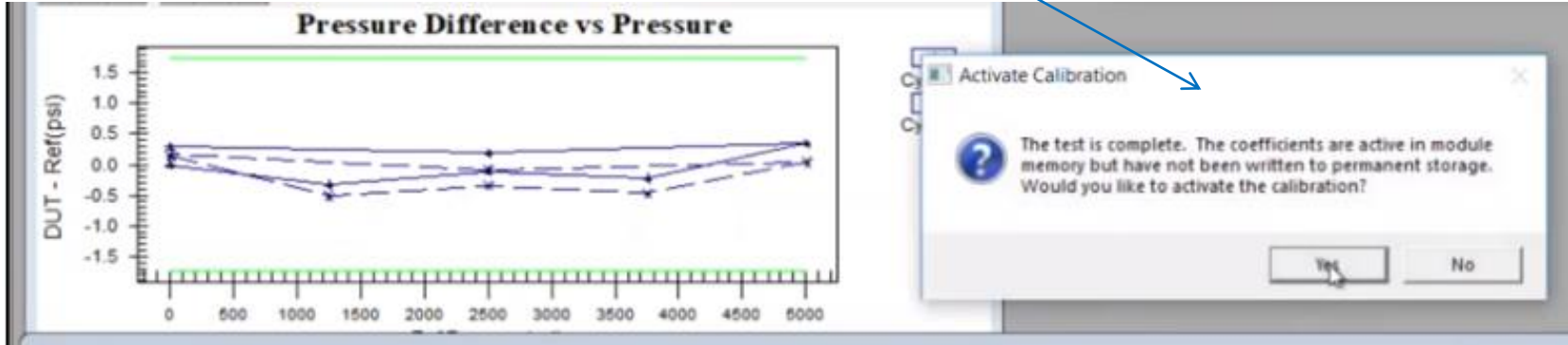
Test Information	
Date	Sep 27 2018
Operator	Kyle Clark
Leak Status	

As Received Data:						
Reference	DUT	Error	DUT tol with GB	Status	Unc	TUR
psi	psi	psi	psi			
0.00	0.00	0.00	1.744	Pass	0.150	
1250.01	1249.68	-0.33	1.743	Pass	0.153	
2500.01	2499.90	-0.11	1.732	Pass	0.250	
3749.99	3749.77	-0.22	1.709	Pass	0.375	
5000.00	5000.34	0.35	1.677	Pass	0.500	
2500.00	2500.25	0.19	1.730	Pass	0.251	
0.00	0.29	0.29	1.744	Pass	0.150	

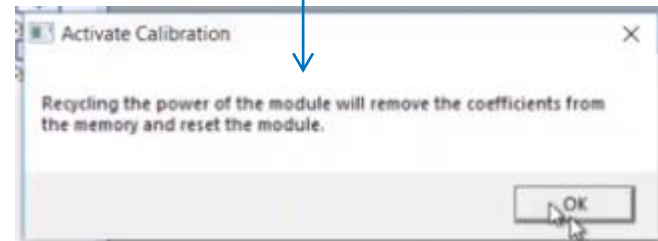
As Left Data:						
Reference	DUT	Error	DUT tol with GB	Status	Unc	TUR
psi	psi	psi	psi			
0.00	0.15	0.15	1.744	Pass	0.150	
1249.99	1249.87	-0.12	1.743	Pass	0.153	
2499.99	2499.65	-0.34	1.732	Pass	0.250	

Run Test – As Left Verification (screen-shot)

Pop up window shows that coefficients are active in the module but not written. Activate yes/no?



Next pop up window shows to cycle the power of the module to remove the new active coefficients.

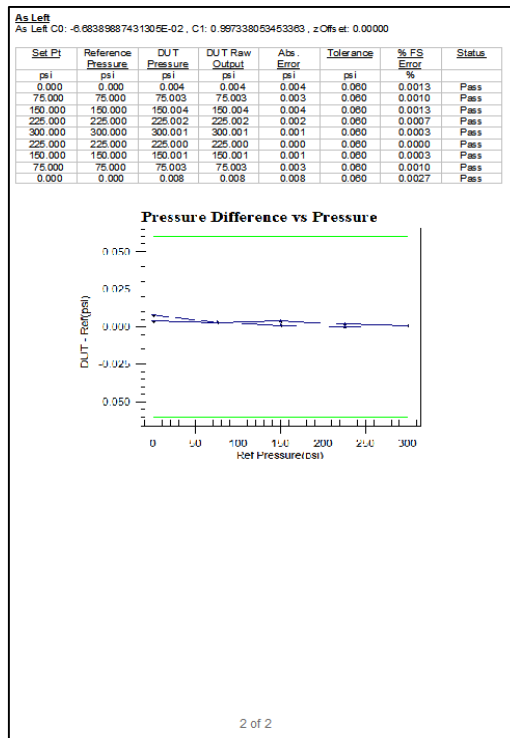
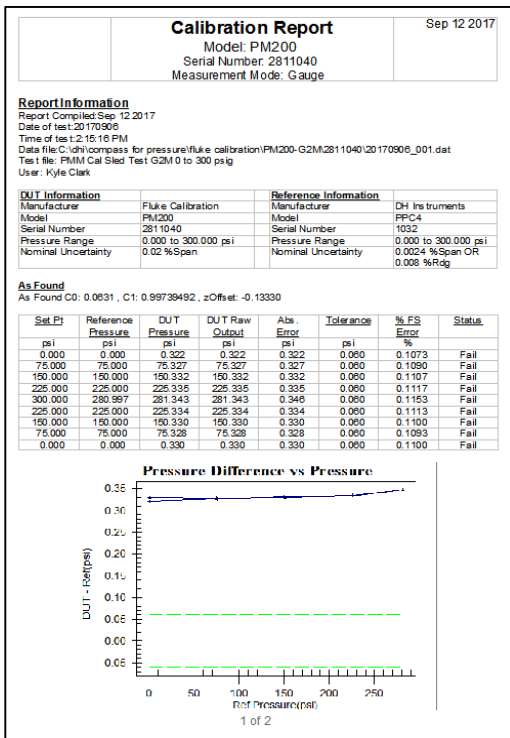


Calibration Report

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Calibration

COMPASS Report Editor Produces professional quality calibration reports




Calibration Report

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— Calibration

COMPASS Report Editor Produces professional quality calibration reports

Title / Header section

		Fluke Calibration 4765 E. Beautiful Lane Phoenix, AZ 85044
— Calibration		
CALIBRATION CERTIFICATE: 2590004-20180927_001.dat		
Device Informaton:	DUT	Reference
Model	FLUKE-750R30	8270A-5
Manufacturer	Fluke	Fluke Calibration
Serial Number	2590004	4143017
Pressure Range	0.000 to 5000.000	
Tolerance	0.035 %FS	
Test Information		
Date	Sep 27 2018	
Operator	Kyle Clark	
Leak Status		

Calibration Report

FLUKE®

Calibration

Data

As Received Data:

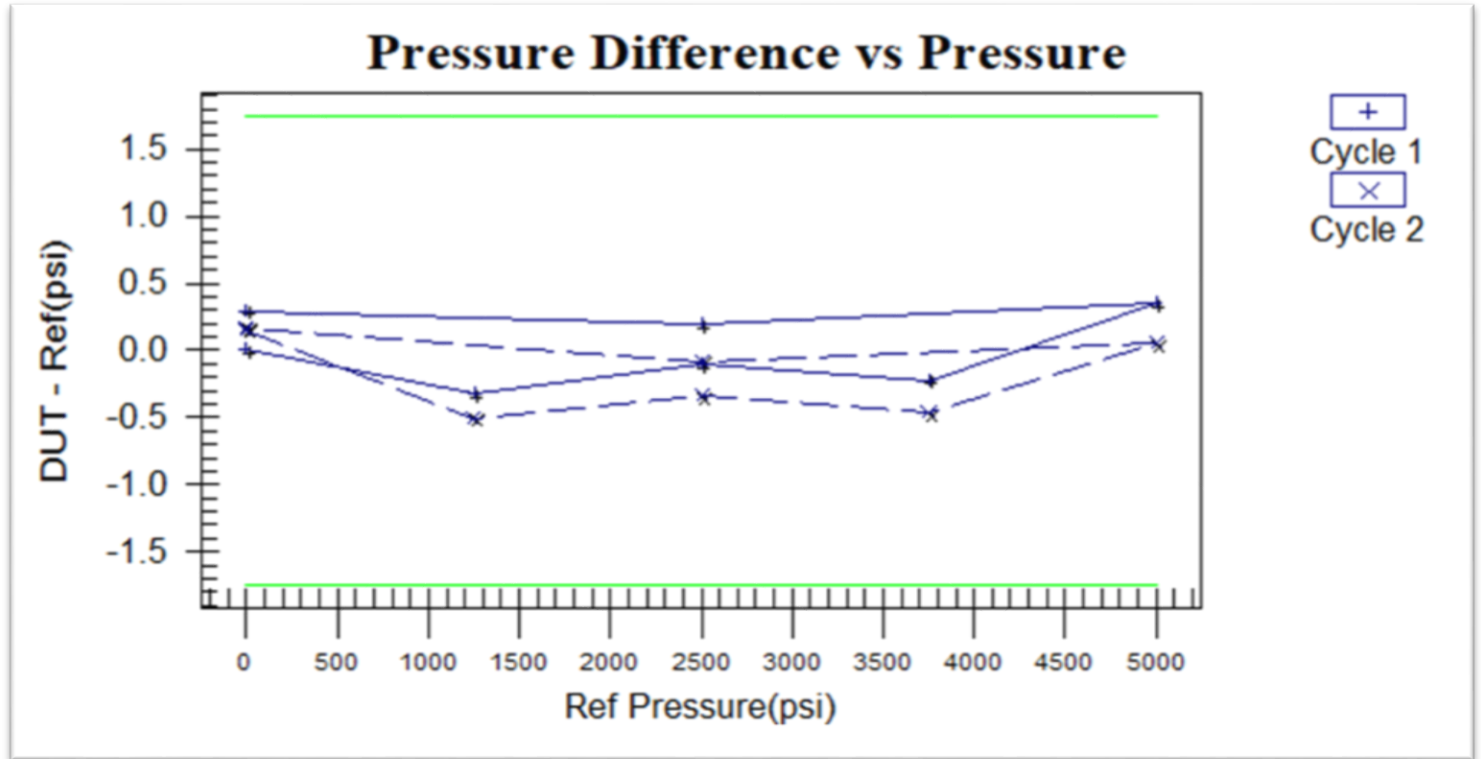
Reference	DUT	Error	DUT tol with GB	Status	Unc
psi	psi	psi	psi		psi
0.00	0.00	0.00	1.744	Pass	0.150
1250.01	1249.68	-0.33	1.743	Pass	0.153
2500.01	2499.90	-0.11	1.732	Pass	0.250
3749.99	3749.77	-0.22	1.709	Pass	0.375
5000.00	5000.34	0.35	1.677	Pass	0.500
2500.06	2500.25	0.19	1.730	Pass	0.261
0.00	0.29	0.29	1.744	Pass	0.150

As Left Data:

Reference	DUT	Error	DUT tol with GB	Status	Unc
	psi	psi	psi		psi
0.00	0.15	0.15	1.744	Pass	0.150
1249.98	1249.47	-0.51	1.743	Pass	0.153
2499.99	2499.65	-0.34	1.732	Pass	0.250
3750.00	3749.53	-0.47	1.709	Pass	0.375
4999.99	5000.04	0.05	1.677	Pass	0.500
2500.01	2499.92	-0.08	1.730	Pass	0.261
0.00	0.17	0.17	1.744	Pass	0.150

Calibration Report

Optional Plot with Tolerance Bars and Legend



Data File

Semi-colon separated file. Can open in Excel

[TEST DATA]											
Point	Date	Time	Elapsed Time	Set Time	Set Point	Reference Pressure	DUT Pressure	DUT Error	Tolerance	Guardband	Status
			s	sec	psi	psi	psi	psi	psi		
[TEST PRESSURE CYCLE]											
1.1	20180927	15:07:01	59.3	16	0	0	0	0	1.75	1.744	Pass
1.2	20180927	15:08:57	174.9	83	1250	1250.01	1249.68	-0.33	1.75	1.743	Pass
1.3	20180927	15:10:22	260.6	60	2500	2500.01	2499.9	-0.11	1.75	1.732	Pass
1.4	20180927	15:11:48	346.4	60	3750	3749.99	3749.77	-0.22	1.75	1.709	Pass
1.5	20180927	15:13:24	442.5	60	5000	5000	5000.34	0.35	1.75	1.677	Pass
1.6	20180927	15:15:28	566.2	81	2500	2500.06	2500.25	0.19	1.75	1.73	Pass
1.7	20180927	15:16:51	649.2	16	0	0	0.29	0.29	1.75	1.744	Pass

PM600-A200K SN3833031
PM600-A40M SN4143003
PM600-A40M SN4143003
PM600-A40M SN4143003
PM600-A40M SN4143003
PM600-A40M SN4143003
PM600-A200K SN3833031

Active Pressure Measurement Module's serial number and model saved for each point. Can be put on cal report if desired

COMPASS Report Editor

Customize template (.tpl) files

- Edit any black/white text (even change language)
- Yellow fields can be selected from the available fields to the left
- Data from data file
- Plots (edit or make new)
- Calculations with Report Macros

Available Data

- [-] General Information
 - [-] Devices
 - [-] General
 - [-] Misc Information
 - [-] Pre Test
 - [-] Test Information
- [-] Test Data
 - [-] Auxiliary Data
 - [-] Calculations
 - [-] DUT Calculations
 - [-] DUT Data
 - [-] General Data
 - [-] Macro Defined Fields
 - [-] Reference Data
 - [-] User Defined Fields
- Macros
 - [-] Excel Field
 - [-] Field Macros
 - [-] Template Macros
- Plots
 - [Add New Plot]
 - [-] %Reading Error vs. Reference Pressure
 - [-] %Span Error vs. Reference Pressure
 - [-] %Span Error vs. Reference Pressure
 - [-] 3D %Error vs Temperature and Pressure
 - [-] Ambient Pressure vs. Points
 - [-] DEFAULT STRIP CHART
 - [-] DUT Pressure vs Points
 - [-] Pressure Difference vs Pressure

Calibration Report Today

Model: **Model**
 Serial Number: **Seria**
 Measurement Mode: **Pres**

Report Information

Report Compiled: **Today**
 Date of test: **Date**
 Time of test: **Test**
 Data file: **Data>Data**
 Test file: **Test**
 User: **Opera**

DUT Information		Reference Information	
Manufacturer	Manuf	Manufacturer	Manuf
Model	Model	Model	Model
Serial Number	Seria	Serial Number	Seria
Identification	Ident	Identification	Ident
Pressure Range	Min O to Max O Unit	Pressure Range	Min O to Max O Unit
Data Acquisition Method	DAQ M	Data Acquisition Method	DAQ M
Nominal Uncertainty	Final	Nominal Uncertainty	Final

As Found
 As Found C0: **Calib**, C1: **Calib**, z Offs et: **Calib**

Set Pt	Reference Pressure	DUT Pressure	DUT Raw Output	Abs. Error	Tolerance	% FS Error	Status
Set P	Pres	Pres	Raw O	DUT -	Toler	%FS E	Statu
Set P	Pres	Pres	Raw O	DUT -	Toler	%FS E	Statu

Pressure Difference vs Pressure

Plot

End of Test

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Calibration

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® feature](#) in COMPASS Report Editor
- Open data file(s) in pre-selected Excel workbook (COMPASS Enhanced)
- Import COMPASS data file into MET/TEAM

COMPASS versions (demo version available)

COMPASS for Pressure, Basic - Most features available

COMPASS for Pressure, Enhanced - All of Basic plus...

- Use of multiple references within a test
- DUTs with multiple outputs or DUTs that also control pressure
- Test event macros
- Single User License included with either version
 - Order additional licenses to run on multiple computers and to share a networked database
- **Demo** of either version is available at no charge at flukecal.com
- Upgrade to current version at flukecal.com

Other COMPASS features

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Calibration

- Temperature Test - Need Enhanced
 - Typically for temperature characterizing pressure sensors
 - Has to be run with a pressure test
- Pressure Test with Line Pressure
 - Often natural gas or steam differential pressure sensors that operate at high line pressures, but low differential pressures
- User and feature display options
 - User levels with passwords
 - Network options – all files that should be backed up on network drive



COMPASS Macro Editor (view of)

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Calibration

Test Macro “Cal700P_Unc” (Specified on the Data tab in the Test)

The screenshot shows the COMPASS Macro Editor interface. On the left, a tree view displays the project structure, with the 'Cal700P_Unc' macro highlighted under the 'Test' folder. The main editor window shows the code for this macro, starting with a title 'Cal700P_Unc' and a line number 5611. The code includes several comments in green text and a function definition for 'Cal700P_Unc' that takes parameters iT, iL, iC, iP, cTest, and cConfig. The function body contains two calls to other macros: 'UncCalc' and 'Fluke700PCalibrationAdjust'. The function ends with 'End Function' at line 5628.

```
5611 |
5612 | *****
5613 | 'Test Macros do not have a return value.
5614 | 'Manipulate the test or device collection as desired.
5615 | 'iT The current temperature point in the test
5616 | 'iL The current line pressure point in the test.
5617 | 'iC The current pressure cycle in the test.
5618 | 'IP The current pressure point in the test.
5619 | 'cTest The test class .
5620 | 'cConfig Configuration class that holds all active devices.
5621 | '
5622 | *****
5623 | Function Cal700P_Unc(iT, iL, iC, iP, cTest, cConfig)
5624 |
5625 |     UncCalc iT, iL, iC, iP, cTest, cConfig
5626 |     Fluke700PCalibrationAdjust iT, iL, iC, iP, cTest, cConfig
5627 |
5628 | End Function
```

1. Test Macro

2. Green text is comments

2. Use this Test Macro to call two other Test Macros; UncCalc Test macro and the 700P Cal Adjust Test Macro. Have to do this because can't specify two Test Macros in the test

COMPASS Macro Editor (view of)

FLUKE®

Calibration

Test Macro “UncCalc” – ISO 17025 Uncertainty Calculation

Search for “COMPASS Uncertainty” in Knowledge Base to find article

```
'This test macro calculates uncertainty for each setpoint in the test
'at the end of the averaging time. Calculation is done per
'Fluke Calibration Application Note -
'"Implementing ISO 17025 Measurement Uncertainty Requirements In Software"
'dated March 2012, document 1282496C
'Search www.flukecal.com for "1282496C" to find this App Note
,
'Make sure UserDefined1, UserDefined2 and StringData1 are saved to the data file in
'[Tools], <Options>, <Data In File>. Need an Advanced test and specify this as the
'"Test Event Macro" on the Data tab, and "Timed Macro Interval(ms)" needs to be 0 (zero).
,
'*****
Function UncCalc(iT, iL, iC, iP, cTest, cConfig)

'Renaming column headers at start of new pressure/flow cycle
If cCOMPASS.CurrentTestStep = 1100 Then
    For i = 1 To cCOMPASS.DataCollection.Count
        cCOMPASS.DataCollection(i).DataInfoCollection("ID410001").Nomenclature = "Uncertainty"
        cCOMPASS.DataCollection(i).DataInfoCollection("ID410002").Nomenclature = "Guardband"
        cCOMPASS.DataCollection(i).DataInfoCollection("ID410501").Nomenclature = "Status GB"
```

COMPASS Macro Editor (view of)

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Calibration

Test Macro “Fluke700PCalibrationAdjust”

```
Function Fluke700PCalibrationAdjust(iT, iL, iC, iP, cTest, cConfig)


Select Case cCOMPASS.CurrentTestStep
  Case 2000 ' Test Complete
    If cTest.TestPrsCycles <> 2 Then 'only support calibration with received and as l
      Exit Function
    End If

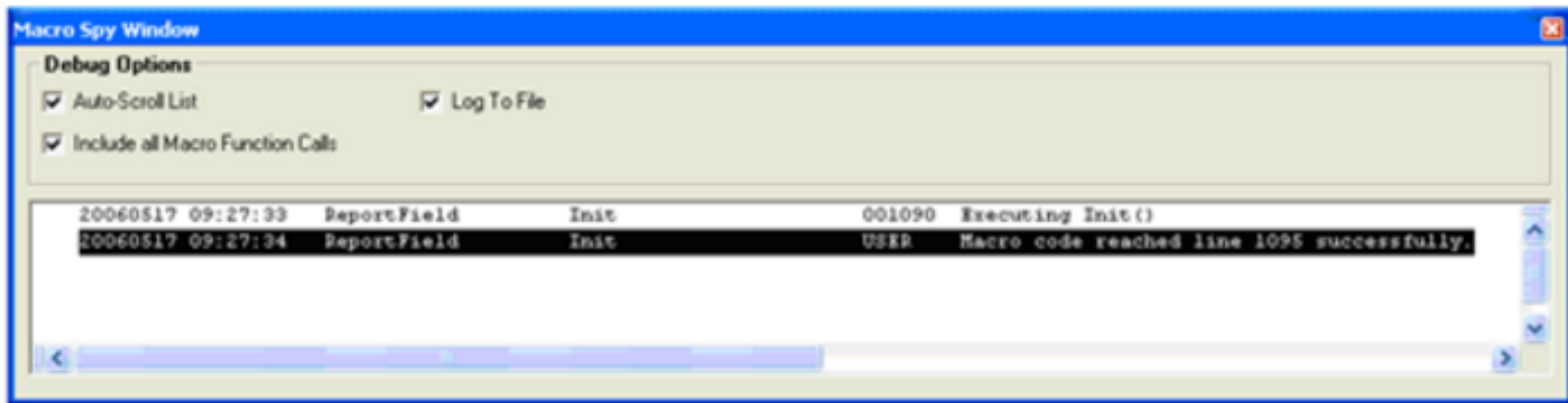
    msg = "The test is complete. The coefficients are active in module memory but "
    msg = msg & "have not been written to permanent storage. Would you like to activat
    msg = msg & "the calibration?"

    If MsgBox(msg, vbQuestion + vbYesNo + vbSystemModal, "Activate Calibration") = vbI
      msg = "Recycling the power of the module will "
      msg = msg & "remove the coefficients from the memory and reset the module."
      MsgBox msg, vbSystemModal, "Activate Calibration"
    End Function
```

Run Test – Display macro spy

Macro Spy (show macro calls and macro debug statements)

- If the test does not have a macro in it, the option to view the macro spy window does not appear
- Click the Device Run Screen Display icon  and select <Show Macro Spy> to bring up the Macro Spy Window



Run Test – Display macro spy

Macro Spy and macstat.log

- Ensure that the “Log To File” and “Include all Macro Function Calls” checkboxes are checked to log any debug statements and macro calls to the file c:\dhi\common\MacStat.log
- Good for investigating problems after the test is done

20180927 13:02:36		Test		Cal700P_Unc		USER		U1 = 7.50000006519258E-02
20180927 13:02:36		Test		Cal700P_Unc		USER		S1 = 1.14552984859643E-03
20180927 13:02:36		Test		Cal700P_Unc		USER		S2 = 2.88675134594813E-02
20180927 13:02:36		Test		Cal700P_Unc		USER		U2 = 2.88902331587573E-02
20180927 13:02:36		Test		Cal700P_Unc		USER		Unc = 0.080371920903735
20180927 13:02:36		Test		Cal700P_Unc		USER		ExpUnc = 0.16074384180747
20180927 13:02:36		Test		Cal700P_Unc		USER		DUT-Ref = -7.06740803245873E-03
20180927 13:02:36		Test		Cal700P_Unc		USER		GB = 1.74260191765016
20180927 13:02:36		Test		Cal700P_Unc		USER		Pass/Fail = Pass

Piston Gauge or Deadweight Tester

FLUKE®

Calibration

Piston Gauge (pressure is calculated)

- Most don't provide a direct pressure output so their metrological values are entered and COMPASS calculates the resulting pressure with all corrections (piston effective area, piston coefficients, true mass values, gravity, temperature, etc.)
- PG7000 and PG9000 reply with the pressure by remote command so metrological values don't have to be entered into COMPASS (but can be)



Setup Piston Gauge or Deadweight Tester

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Calibration

Deadweight Tester (pressure values on masses)

- Pressure values for each mass are entered
- COMPASS can apply a gravity correction
- If you have the metrological parameters you can setup the DWT as a piston gauge



COMPASS Piston Gauge Calculator

FLUKE®

Calibration

Piston Gauge Calculator

Piston Gauge Platform: Ruska 2465-754
Piston-Cylinder: 2465 Lo Range PC
Mass Set: Ruska 2465-799 MS
Trim Mass Set: None
Mass Bell: Ruska 2465-799 Sleeve Weight
Medium: N2 Nitrogen
Measurement Mode: Gauge

Ambient Temperature (C): 20.00
Ambient Humidity(%RH): 50.
Ambient Pressure (kPa): 100.00
Ambient Pressure Height (cm): 0.00
Vent Height (cm): 0.0
Head Height (cm): 0.0

P-C Temperature (C): 23.00

Piston Position (mm): 0.0
Local Gravity (m/s²): 9.79474
Mass Loading Resolution: 1g
Pressure Display Resolution: 0.0001

Pressure (psi): 3 2.9939

True Mass (kg): 0.707621

Nominal Mass (kg): 0.710000

Mass List

- Piston 0.04700 kg
- 1 Bell 0.500000 kg
- 14 0.010000 kg
- 13 0.020000 kg
- 12 0.030000 kg
- 11 0.050000 kg
- 10 0.100000 kg
- 9 0.200000 kg
- 8 0.300000 kg
- 7 0.500000 kg
- 2 1.000000 kg
- 3 1.000000 kg
- 4 1.000000 kg
- 5 1.000000 kg

Masses To Load

- Piston 0.04700 kg
- 1 Bell 0.500000 kg
- 14 0.010000 kg
- 11 0.050000 kg
- 10 0.100000 kg

Calculations

Air Density (P,T): 1.1834
Mass Density: 7.7932E+03
Area (P,T) (m²): 3.3572E-04

Head Total (Pa): 0.0452
Density 1: 1.3729
Head 1 (Pa): 0.0000
Density 2: 0.0000
Head 2 (Pa): 0.0000
Piston Height (m): 0.0244
Piston Head (Pa): 0.0452
ATM Head (Pa): 0.0000

(* Density in kg/m³)

Close

Other COMPASS resources

FLUKE®

Calibration

- Application Notes
 - Knowledge and Information tab of the COMPASS for Pressure web page at flukecal.com
- Overview and video tutorial files
 - Online Knowledge Base at support.flukecal.com
- Miscellaneous
 - Search Fluke Calibration website flukecal.com for “COMPASS for Pressure”

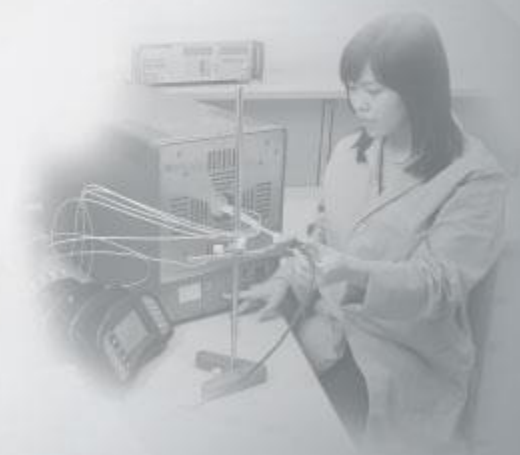
Other COMPASS resources

- Example macros
 - Look through the COMPASS Macro Editor
 - [Ctrl] + [F] for the Find/Search window
 - Copy the text from a macro to a new macro and edit it
 - **The macros in this example are a great template for many devices**
 - Search the COMPASS Macro Editor help file
 - Search the COMPASS help file (yes, two different help files)
- Contact Pressure Technical Support
pressuresupport@flukecal.com
- Onsite training by Pressure Technical Support team

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Calibration

Thank you – Questions?





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Thank you

Be the first to know. Sign up for Fluke Calibration e-news bulletins, and the quarterly *Total Solutions in Calibration* newsletter:

www.flukecal.com/signmeup



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