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Calibration Experts

FLUKE®
Calibration

End-to-end automated calibration of Fluke 700 Pressure Modules using COMPASS® for Pressure Calibration Software v 4.0

Application Note

This application note describes how a pressure calibration laboratory can improve throughput by fully automating the calibration of Fluke 700 Series Pressure Modules.

Items required include:

- COMPASS® for Pressure Calibration Software Version 4.0
- Computer with access to at least two COM ports
- Automated pressure controller
- PK-700-CAL: 700 Series Pressure Module Calibration Kit

History of automating pressure calibrations

Pressure calibrations have progressively become more automated over the last 30 years. This automation began with the introduction of programmable pressure controllers/calibrators in parallel with the emergence of the computer age. Where pressure calibrations had traditionally been labor intensive, manually operated processes, the pressure controller opened the door to automating this process.

At first, automation was limited to production and characterization processes at pressure instrumentation manufacturers, whose output was electronic (for example, transmitters/transducers). The first generation of pressure controllers included an electronic interface with a command set that allowed test engineers to write customized programs. These programs sent commands to the pressure controller, instructing it to set a desired pressure.

Once the controller stabilized the pressure at the target point, the program would record the pressure value of the controller's reference sensor and also record the value(s) of the instruments being tested. The programs would also communicate with other test hardware necessary for the pressure testing, for example, thermal chambers or programmable power supplies.

While the advent of pressure calibration automation in a production or testing environment was a boon for manufacturers, pressure calibration laboratories usually could not take full advantage of the potential automation. While they now had access to a device that would set pressure automatically, they did not have the resources to develop the calibration management software that could leverage the true automation capabilities.

DH Instruments recognized this problem/opportunity and in the early 2000s introduced COMPASS for Pressure Calibration Software. With COMPASS software, calibration laboratories that utilized a DHI pressure controller were able to run fully automated tests, as received and as left, on any pressure instruments whose output was electronic. Now an operator could create and save test sequences that reflected the pressure points at which he wanted to compare the results of the reference controller and the units or devices under test (UUTs or DUTs).

Not only did COMPASS software communicate with the reference controller and the DUT, but also with other test instruments like temperature/humidity monitors, programmable power supplies and barometers. COMPASS software ran the test, collected data from all of the measurement instruments in the test, and then stored the data in a data file unique to each DUT for each calibration. COMPASS's report editor could be used at the completion of each test to immediately generate a customized calibration report. This report could include standard calculations such as linearity or repeatability as well as custom graphs. Data could also easily be exported to other software applications for manipulation and/or reporting.

Automated adjustments, the final task for a completely automated calibration

The capability to run completely automated pressure tests using a commercially available software platform (COMPASS) was a monumental step in the goal to automate pressure calibrations. However, it was not the final step.

A complete calibration includes making adjustments to the test instruments so that the instrument's output is within acceptable measurement specifications. With legacy transmitter/transducer products, this part of the process typically meant adjusting a potentiometer manually until the voltage or current output was within specifications. For digital devices, this meant determining calibration coefficients and manually entering them into the device.

A calibration process cannot be considered completely automated unless all parts of the process are automated. The final part of this process is to automate the adjustment process.

Automating the complete calibration process for a Fluke 700P pressure module

COMPASS for Pressure version 4.0 includes the functionality to remotely adjust the first of what will likely be numerous digital handheld pressure calibrators. With COMPASS for Pressure loaded on a PC, an automated pressure calibrator and the Fluke Calibration PK-700-CAL calibration kit (including both hardware and software), any calibration laboratory can now run a fully automated, unattended calibration on one or more 700P modules.

PK-700-CAL 700 Series Pressure Module Calibration Kit

With this configuration, COMPASS software runs a complete "as received" test with test points defined by the operator. At the conclusion of the "as received" sequence, COMPASS software calculates the optimal coefficients for each pressure module, and then runs a routine that programs the pressure module with these coefficients. Following the reprogramming of the module, COMPASS runs an "as left" test sequence.

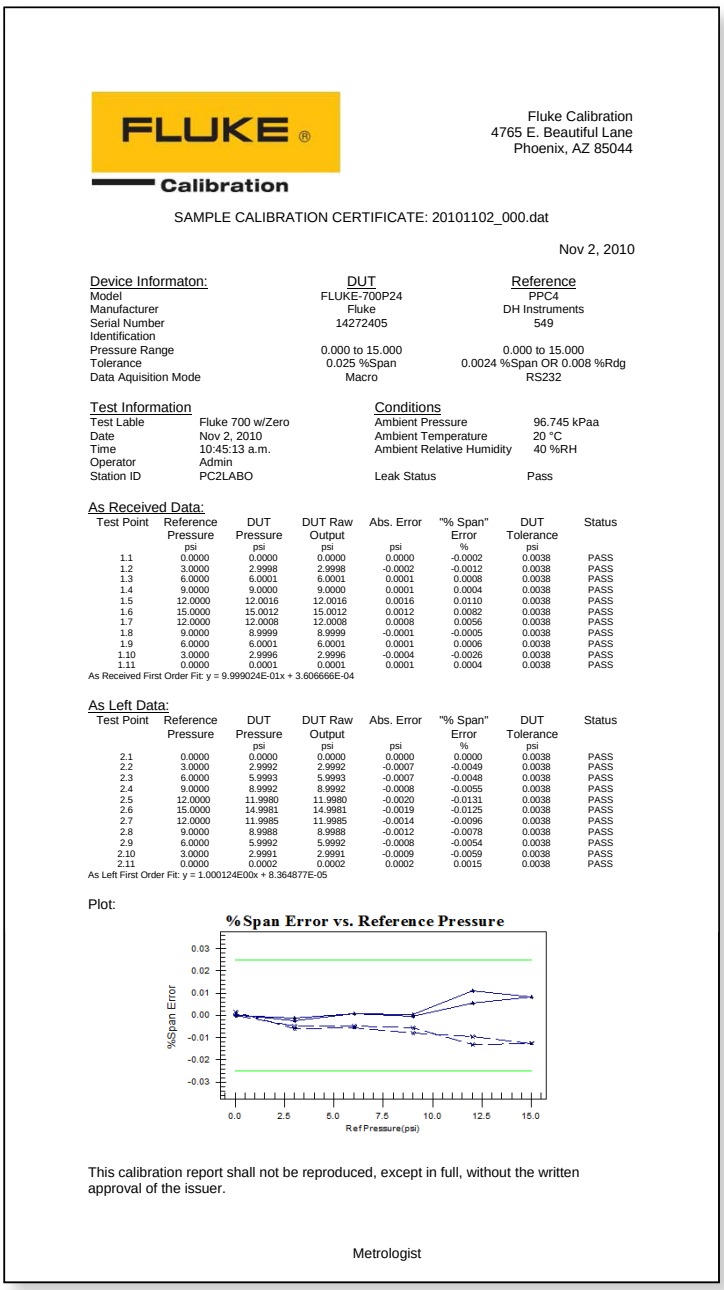
At the conclusion of the "as left" sequence, COMPASS software can generate a customized calibration report that includes both "as received" and "as left "data as well as any other information (calculations, graphs, text) that the operator wants to include.

The bottom line: Significant process improvement gains

There are two major advantages to automating the calibration process. One is the resulting improvement in quality that is realized when operators are removed from process of writing or keyboarding test data. While any operator is subject to periodically entering incorrect data, it is highly improbable that the electronic communication of data between the instrument and COMPASS will be corrupted. In addition, COMPASS can take data over an averaging period that enables data variability to be minimized.

The other, very powerful, advantage to automating the process is the substantial time savings that results. Without COMPASS, the operator is either setting test pressures manually using a deadweight tester (or a reference pressure readout device with manual pressure control accessory) or by pushing buttons on the front panel of an automated pressure controller. In both cases the operator must engage interactively with the process and therefore his time is consumed by the entire process. The amount of operator time that the process consumes varies by many factors and can range from 15 minutes to 1 hour. In addition, there may be post test data entry/ data processing/report generation processes that will consume either the operator's time or an administrator's time.

By running a completely automated calibration with COMPASS, the amount of operator time that is consumed by setting pressures and taking data falls to near 0. Once management is confident in the results produced by an automated test, the calibration process can run unattended and therefore enable the operator to accomplish other tasks concurrently to the pressure calibration process. The greatly improved throughput portends much lower labor cost and therefore higher margins that enable the calibration lab to make more money.



FLUKE ® Calibration

Fluke Calibration
4765 E. Beautiful Lane
Phoenix, AZ 85044

SAMPLE CALIBRATION CERTIFICATE: 20101102_000.dat

Nov 2, 2010

Device Informaton:	DUT	Reference
Model	FLUKE-700P24	PPC4
Manufacturer	Fluke	DH Instruments
Serial Number	14272405	549
Identification		
Pressure Range	0.000 to 15.000	0.000 to 15.000
Tolerance	0.025 %Span	0.0024 %Span OR 0.008 %Rdg
Data Aquisition Mode	Macro	RS232

Test Information		Conditions	
Test Lable	Fluke 700 w/Zero	Ambient Pressure	96.745 kPaa
Date	Nov 2, 2010	Ambient Temperature	20 °C
Time	10:45:13 a.m.	Ambient Relative Humidity	40 %RH
Operator	Admin		
Station ID	PC2LABO	Leak Status	Pass

As Received Data:

Test Point	Reference Pressure	DUT Pressure	DUT Raw Output	Abs. Error	"% Span" Error	DUT Tolerance	Status
	psi	psi	psi	psi	%	psi	
1.1	0.0000	0.0000	0.0000	0.0000	-0.0002	0.0038	PASS
1.2	3.0000	2.9998	2.9998	-0.0002	-0.0012	0.0038	PASS
1.3	6.0000	6.0001	6.0001	0.0001	0.0008	0.0038	PASS
1.4	9.0000	9.0000	9.0000	0.0001	0.0004	0.0038	PASS
1.5	12.0000	12.0016	12.0016	0.0016	0.0110	0.0038	PASS
1.6	15.0000	15.0012	15.0012	0.0012	0.0082	0.0038	PASS
1.7	12.0000	12.0008	12.0008	0.0008	0.0056	0.0038	PASS
1.8	9.0000	8.9999	8.9999	-0.0001	-0.0005	0.0038	PASS
1.9	6.0000	6.0001	6.0001	0.0001	0.0006	0.0038	PASS
1.10	3.0000	2.9996	2.9996	-0.0004	-0.0026	0.0038	PASS
1.11	0.0000	0.0001	0.0001	0.0001	0.0004	0.0038	PASS

As Received First Order Fit: y = 9.999024E-01x + 3.606666E-04

As Left Data:

Test Point	Reference Pressure	DUT Pressure	DUT Raw Output	Abs. Error	"% Span" Error	DUT Tolerance	Status
		psi	psi	psi	%	psi	
2.1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0038	PASS
2.2	3.0000	2.9992	2.9992	-0.0007	-0.0049	0.0038	PASS
2.3	6.0000	5.9993	5.9993	-0.0007	-0.0048	0.0038	PASS
2.4	9.0000	8.9992	8.9992	-0.0008	-0.0055	0.0038	PASS
2.5	12.0000	11.9980	11.9980	-0.0020	-0.0131	0.0038	PASS
2.6	15.0000	14.9981	14.9981	-0.0019	-0.0125	0.0038	PASS
2.7	12.0000	11.9985	11.9985	-0.0014	-0.0096	0.0038	PASS
2.8	9.0000	8.9988	8.9988	-0.0012	-0.0078	0.0038	PASS
2.9	6.0000	5.9992	5.9992	-0.0008	-0.0054	0.0038	PASS
2.10	3.0000	2.9991	2.9991	-0.0009	-0.0059	0.0038	PASS
2.11	0.0000	0.0002	0.0002	0.0002	0.0015	0.0038	PASS

As Left First Order Fit: y = 1.000124E00x + 8.364877E-05

Plot:

Metrologist

COMPASS for Pressure calibration report

How to set up and run an automated calibration of a Fluke 700P pressure module

As mentioned above, COMPASS software allows for the calibration of up to 10 modules of the same pressure range at a time. While calibrating multiple instruments in parallel is definitely an attractive option, in order to accomplish this, the calibration needs to have one PK-700-CAL calibration kit per module being tested. The calibration laboratory manager has to decide if it is worth the added cost. The pressure module calibration kit is available from your local Fluke Calibration sales representative.

While an operator can use any manufacturer's pressure controller as the reference instrument for running an automated test, it is easiest to use COMPASS software with a Fluke Calibration pressure controller. To calibrate pressure module ranges from inches of water up to 3,000 psi, the lab can use a 7250 or PPC4 series pressure controller. Choose the 7250 if premium accuracy is required for the calibration; choose the PPC4 if value is the primary selection criteria.

For higher pressure calibrations up to the 10,000 psi maximum, the 7615 and PPCH models are available.

The computer must communicate with each PK-700-CAL calibration kit via a com port, and the computer also commonly communicates with the pressure controller via a com port. This may cause a problem initially with modern computers since the com port is disappearing. If this is the case, it is very common to use a USB-to-multi-com-port-hub to provide the number of com ports needed for a test.

Once all of the hardware is connected properly, it is necessary to set up COMPASS software to run the specific calibration. Assuming the operator is somewhat familiar with how to use COMPASS software, it is easy to configure it for this specific task. A technical application note under the Knowledge and Information tab at www.flukecal.com/compass provides step-by-step instructions for the user to follow to prepare COMPASS to run a fully automated Fluke 700P pressure module calibration. By adhering to the instructions in this application note, the calibration lab will be ready to run a fully automated calibration.

There is also a recorded web seminar, produced in late 2010, that is available as a visual demonstration of this capability. This recorded seminar, titled "Automating Pressure Calibration," may be downloaded from the Fluke Calibration and Metrology Series Seminar Series Archives page at www.flukecal.com/training/web-seminars/archives.

Imagine setting up a calibration just prior to the end of a long day. Upon initiating the test, you shut off the lights, lock the door and head home for the day. When you arrive back at the lab early the next morning, the calibration is complete and you are ready to calibrate the next instrument.

Fluke controller/calibrator models recommended for calibrating 700P pressure modules are 7250i or 7250xi for modules with ranges up to 20 MPa (3,000 psi), and PPC4 with standard Q-RPTs for modules with ranges up to 14 MPa (2,000 psi). To achieve the lowest uncertainty, 7250xi should be used. For low inches of water range modules, 7250LP is offered.

For higher pressure module calibrations up to the 10,000 psi maximum, the 7615 and PPCH models are the controllers to choose.

COMPASS can potentially be used to perform automated adjustments of other interfaceable calibrators and measurement devices.

Beyond the 700P; automated calibration of other digital devices

COMPASS for Pressure was designed to be an open ended, versatile automation package. Its ability to run completely automated calibrations is not limited to the 700P modules. With knowledge of how to remotely program other digital pressure instruments like those from Ashcroft, Crystal, Beamex, Druck and Meriam, COMPASS software's ability to run automated calibrations can be extended to those products as well.

Because the 700 Series modules are engineered by Fluke, Fluke Calibration enjoyed easy access to technical information. Once the programming information is available for other instruments, Fluke Calibration or a savvy COMPASS for Pressure user will be able to add the capability to run completely automated calibrations of these instruments.

COMPASS software version 4.0

COMPASS version 4.0 includes two attractive features that further enhance the software's value to the pressure calibration lab.

Prior to version 4.0, COMPASS was only available to purchase in either single license packages or in a site license package that includes 10 user licenses. There was not a cost effective path for the laboratory manager who wanted to grow into COMPASS software by purchasing incremental licenses as the need arose. With COMPASS 4.0, the licensing structure has changed so that a laboratory can purchase subsequent licenses at an attractive price, one at a time.

Another major COMPASS enhancement in version 4.0 is a much improved interface between COMPASS and MET/CAL ® Plus Calibration Management Software. For laboratories who have standardized reporting and asset management using MET/TRACK software, the process to migrate data from a COMPASS data file to MET/TRACK has been improved so that multiple standards and customized fields can be used easily and the migration process is even more transparent.

Summary

As calibration laboratories continually have to figure out how to do more with less, automating calibration processes is of utmost interest.

With pressure calibrations, the task is to automate a process that at one time was completely manual and inherently very time consuming.

The advent of automated pressure controllers made it possible to automate parts of the process, but complete automation eluded the majority of calibration providers.

With the introduction of COMPASS for Pressure, Fluke Calibration (originally DH Instruments) provided the calibration laboratory a tool to automate much, but not all, of the calibration process. Further development of COMPASS software has led to the release of version 3.0 and now 4.0, which enables the calibration laboratory to run a completely automated, unattended, calibration of a Fluke 700P pressure module.

In the future, with information from manufacturers of other digital pressure devices, it will eventually be possible to run fully automated calibrations of these devices as well. Not only will COMPASS do its part to help the calibration laboratory do more with less, the results of these automated tests should be more reliable as well.

europascal GmbH

An der Wiesenhecke 10
D – 63456 Hanau
Tel.: +49 (0) 6181 / 42309-0
Fax: +49 (0) 6181 / 42309-22

e-Mail: service@europascal.de
Internet: www.europascal.de
Ident.-Nr.: DE812987573