

# Fluke Calibration (FCAL)

## Overview



# Fluke – Part of DHR's T&M Platform



47,000 associates worldwide, ~50% outside U.S

\$11B revenues, 52% outside of U.S

Portfolio of strong brands

Strong core values, driven by DBS

Strong Growth 5-7%

Superior Cash Flow

Customer Focused

Outstanding Brands



Environmental



Hand Tools



Motion



Test &  
Measurement



Life Sciences

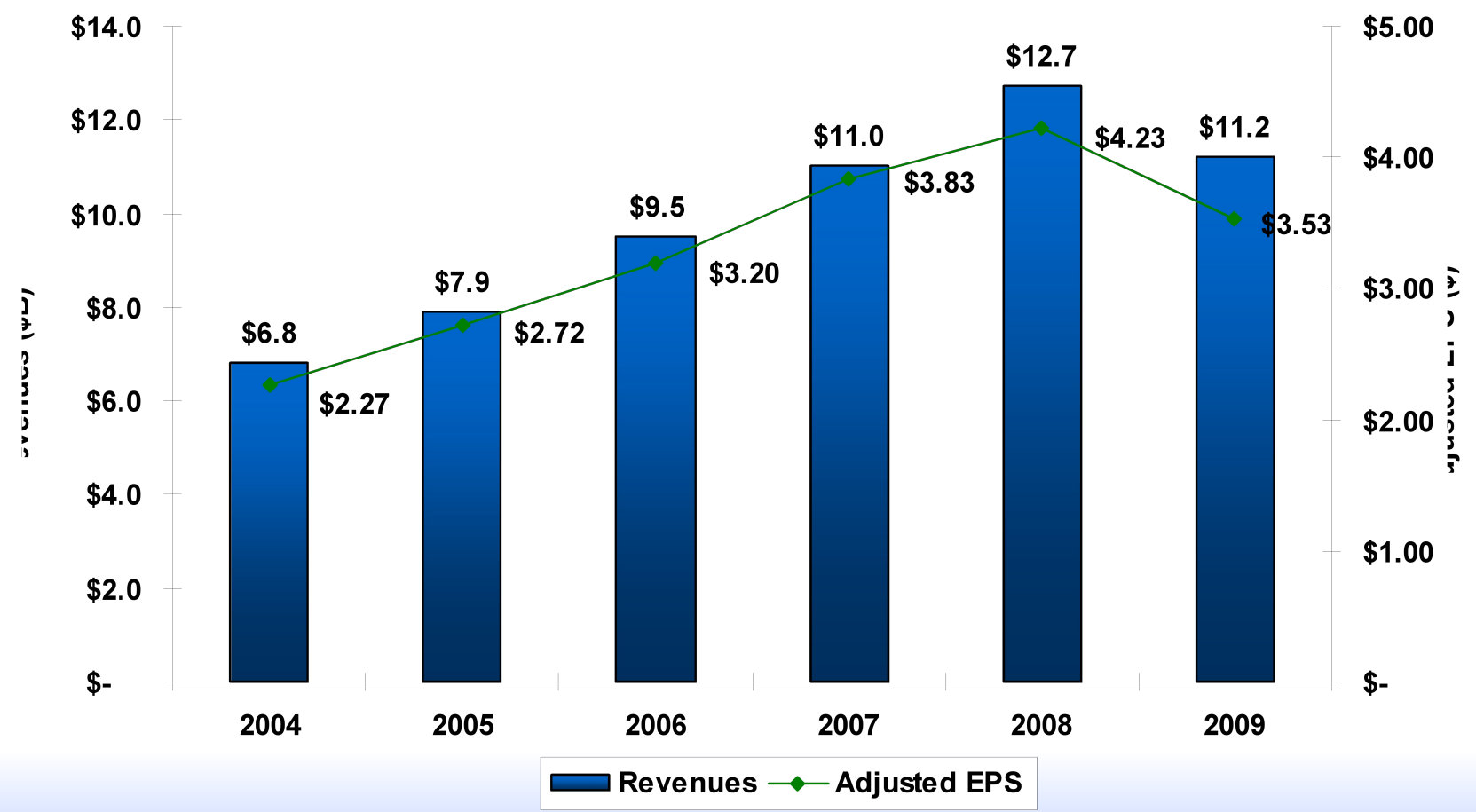


Dental



Product ID

# Danaher – Growth through “DBS”



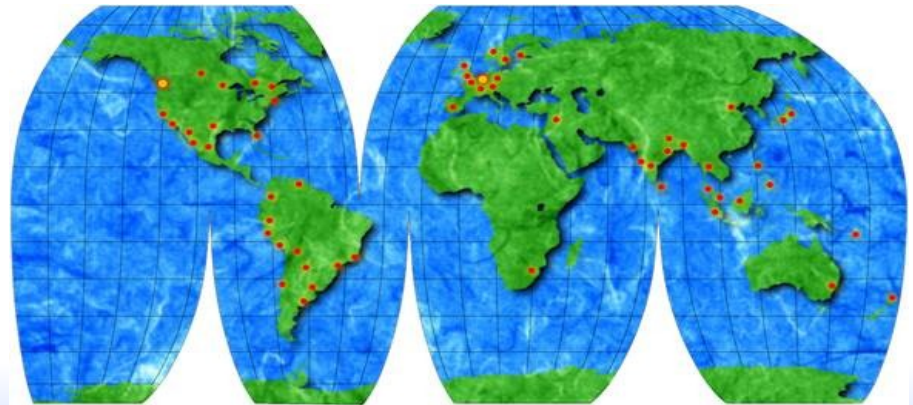
- Founded in basement of John Fluke's home in Springdale, Connecticut in 1948
- 1<sup>st</sup> product was to manufacture Power Meters for General Electric in 1949



- Located 30 km north of Seattle
- 2,400 employees worldwide
- Distributed in more than 100 countries
- Fluke brands:



- Achieved \$1B in revenue in 2008
  - More than doubled in size since acquired by DHR in 1998
  - Acquisition & Organic growth
- Offices in 21 countries
- Manufacturing facilities in the U.S., Germany, The Netherlands, U.K., and China
- Sales and service subsidiaries located in:
  - Europe
  - North America
  - South America
  - Asia
  - Australia



# FCAL Historical Highlights

**FLUKE**®

Calibration



**1952**  
1st Precision Power Supplies



**1967**  
1st Multifunction Calibrator



**1973**  
1st Precision DMM with True-RMS



**1978**  
1st DMM with Autocal



**1988**  
5700 Multifunction Calibrator

**1994**  
Met/Cal for Windows



**2007**

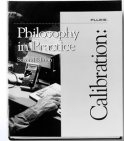
DH Instruments Acquired

**1996**  
9500 Oscilloscope Calibrator



**1970**  
1st Automated Scope Calibration

**1977**  
The "Cal Book" is Published



**1983**  
High Power AC Calibrator



**1995**  
5500 Multifunction Calibrator

**2000**  
Wavetek Precision Measurement Acquire



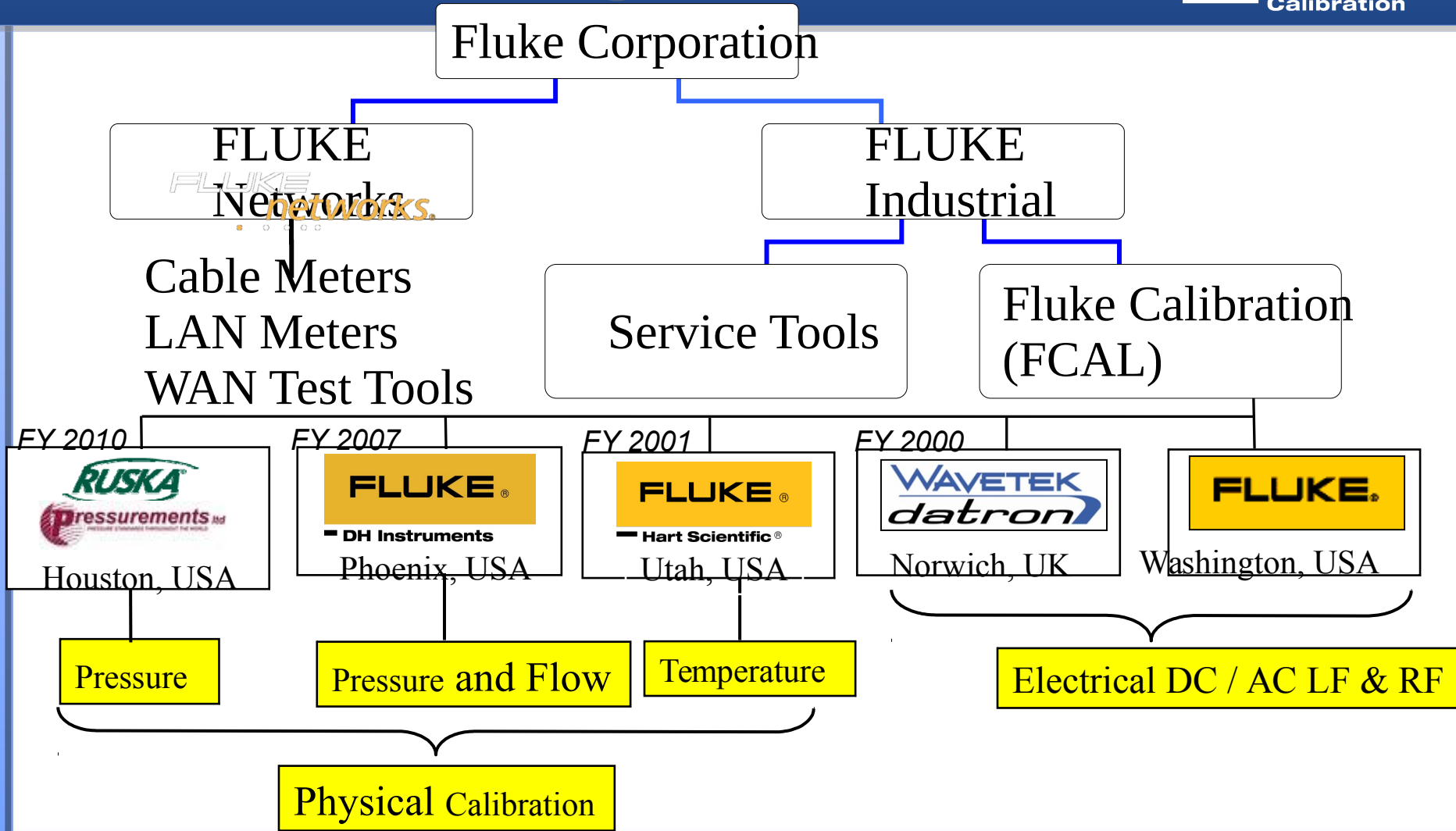
**2001**  
Hart Scientific Acquired



**2010**  
Ruska & Pressurements Acquired



# The Fluke & FCAL Organization





# Where are we located ?



**Fluke Corporate HQ, Everett,  
Washington, USA**



**Fluke DHI Instrument :-  
Pressure and Flow HQ,  
Phoenix AZ • USA**



**Fluke Hart Scientific Temperature HQ,  
American Fork, Utah, USA**



**Ruska & Pressurements  
Texas Houston • USA**

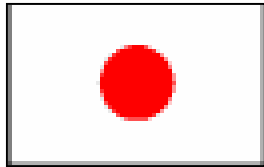


**Fluke Precision Measurement Ltd  
(Formerly Wavetek-Datron),  
Norwich, UK**



## What’s in this for our customers ?

- More great calibration **products**, brought to market faster as we share and leverage engineering resources between product disciplines
- A more unified **software** platform with cross-discipline compatibility
- Better-coordinated pre- and post-sales **support**, making it easier for customers to get answers and help when they need it
- Better-coordinated **training** programs
- A single, global Fluke Calibration **web site** with product and application information
- A clear **identity** for the calibration products, separate from the Fluke industrial product groups

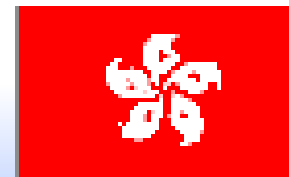


**Subsidiaries  
in Japan,  
China,  
Singapore,  
India and  
Australia**

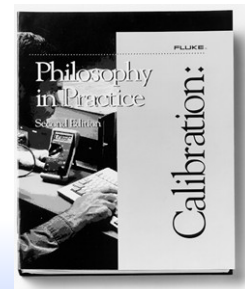
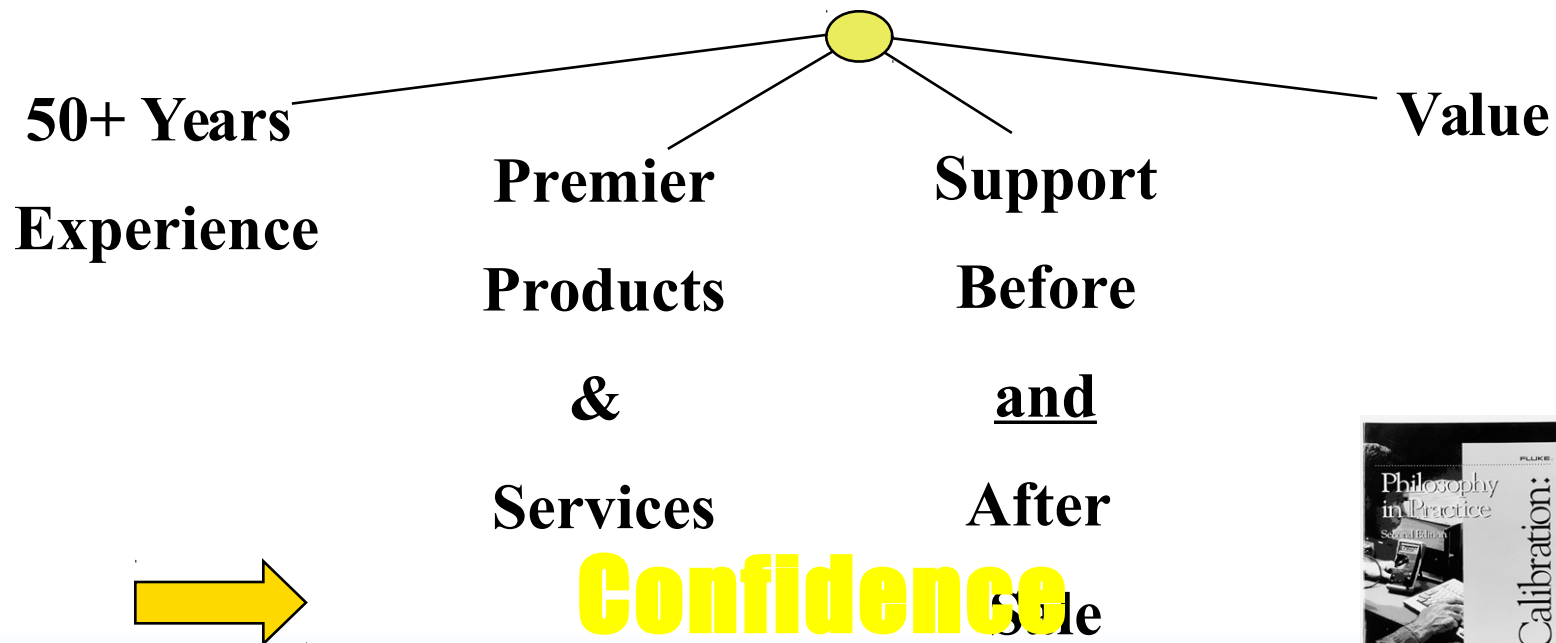


**Representative  
offices in  
China,  
Malaysia, Hong  
Kong and  
Taiwan**

**Joint venture  
company in  
Korea**



“Be the world’s leading source of hardware, software, *and* service solutions addressing industry’s need to maintain measurement quality and traceability.”

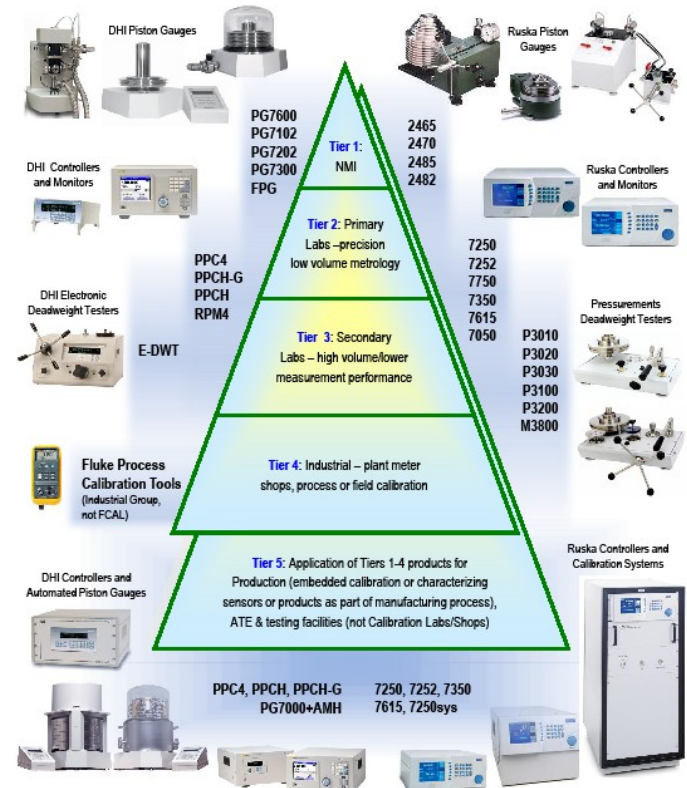


***Put your trust in the leader***

# Fit Into FCAL Business

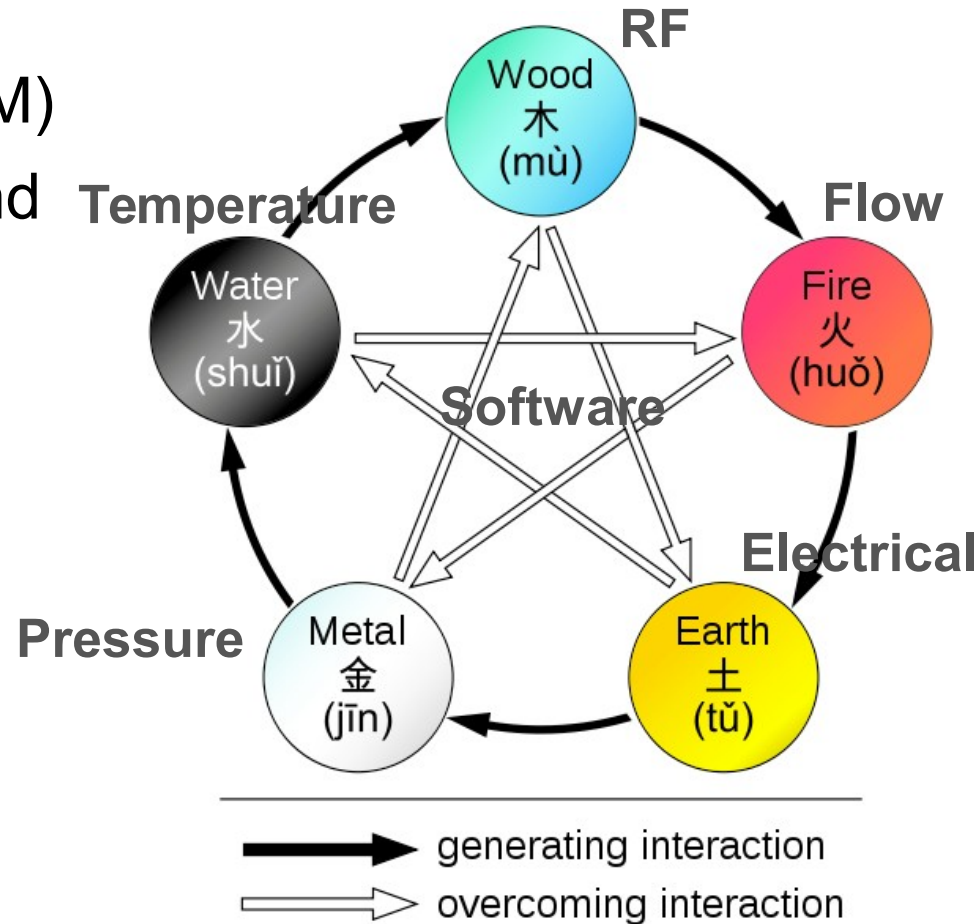
- Fluke Calibration acquired a product line in Ruska that is in the same space, but highly complementary to DHI products
- Fluke Calibration acquired a product line in Pressurements that is in new space, moving down the measurement pyramid
- Ruska/Pressurements gained a much better platform for products, with a company focused on calibration
- Review attached Product Position Guide to learn about position of DHI, Ruska and Pressurements

## Pressure Calibration Solutions DH Instruments, Ruska, Pressurements



# Fluke Calibration

- World's largest calibration focused business (~\$200M)
- A global sales, service, and manufacturing operation
- Solutions in
  - Electrical Calibration
  - Temperature Calibration
  - Pressure & Flow Calibration



# DHI – A Fluke Company

**FLUKE**®

Calibration

**FLUKE**®

**DH Instruments**

**DHI** DH Instruments  
A Fluke Company

**DHI**®



- 1980** Founded by Martin Girard and Pierre Delajoud in Pittsburgh, PA as N. American distributor for a French pressure standard manufacturer (Desgranges et Huot)
- 1984** Open office in Phoenix, AZ and completed move to AZ in 1986. Begin software and systems development
- 1988** French supplier acquired by outside investor. DHI remains independent, and begins development of proprietary products
- 1989** Introduce first generation pressure controller/calibrators and monitors
- 1990** Introduce first primary pressure standard (piston gauge)
- 1990** Introduce molbloc/molbox low gas flow calibration system. Sales of DHI products exceed sales of distributed products (\$2 million)
- 1996** Win first major military contract. 250 pressure controllers for USAF
- 1998** Introduce COMPASS for PPC/RPM, first calibration software product
- 2002** First discussions about future with Fluke 25% sales drop  
Maintain R&D capability and concentrate resources on new product development
- 2005** Win prestigious USAF primary pressure standard replacement contract
- 2007** DHI acquisition by Fluke completed

- Activity** : Design, assemble, test high end pressure and flow calibration equipment. Provide calibration and training services.
- Location** : Phoenix, Arizona, USA
- Market** : Worldwide, 36% export
- Personnel** : 80
- Facilities** : 24,000 ft<sup>2</sup> with 5,000 ft<sup>2</sup> calibration lab

- 1937 Walter Ruska Company – Volumetric Pumps & Geophones
- 1944 Incorporated as Ruska Instrument Corporation – PVT (Pressure Volume temperature) instrumentation
- 1955 Designed and built Deadweight Gauge
- 1958 Production of quartz tube pressure gauges with Worden Laboratories
- 1959 First Quartz based pressure sensor product shipped
- 1960 First Ruska Pressure Metrology School started
- 1965 Ruska acquired Worden Quartz**
- 1972 First Forced-Balance Quartz Bourdon Sensor DDR 6000
- 1996 Druck Holdings plc of Leicester, England purchased Ruska**
- 2001 PVT Laboratory Instrumentation sold to Chandler Engineering
- 2001 NVLAP Accredited in Pressure
- 2002 Pressurements Industrial Deadweight Gauge (DWG) transferred from UK to Houston
- 2002 GE acquired Druck Companies**
- 2003 SI Industrial DWG production was purchased and transferred from UK to Houston
- 2005 Druck Inc. in Connecticut transferred ADTS product line to Houston site
- 2006 AS9100 and ISO 9001 Certified
- 2007 Pressurements and SI designs consolidated
- 2009 VPP OSHA Star Site Certified
- 2010 Fluke acquired Ruska & Pressurements Companies from GE**

## Ruska

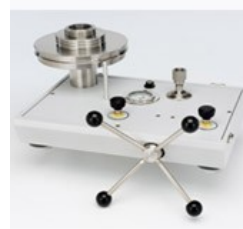
- Recognized world wide in pressure metrology
- Wide portfolio of state of the art pressure standards



51% of '09 Orders

## Pressurements

- High performance, cost effective pressure measurement solutions
- Wide product portfolio



23% of '09 Orders

## Quartz Fabrication

- Uniquely, one-of-a-kind leader in custom quartz fabrication
- Custom Heater applications
- Analytical Instrumentation specialty parts



6% of '09 Orders

## Services

- Highly skilled, knowledgeable technicians utilizing state-of-the-art pressure standards to perform NVLAP accredited calibrations



20% of '09 Orders

# Market by Company

<p>Telecommunications</p> <p>Automotive</p> <p>Military</p> <p>Aerospace</p> <p>Chemical</p> <p>Pharmaceutical</p> <p>Process</p> <p>Medical</p>	<p>National Labs</p> <p>Accredited Labs</p> <p>Calibration Labs</p> <p>Maintenance Labs</p>
<p>Gov/Research/Education</p> <p>Consumer Goods</p> <p>Utilities</p> <p>Rental/Lease Equipment</p>	<p><b>Metrologist or Head of Metrology</b></p> <p><b>Doctor of Science PhD.</b></p> <p><b>Research Engineer</b></p> <p><b>Calibration Lab Manager</b></p> <p><b>Asset Manager</b></p> <p><b>Calibration Lab Engineer</b></p> <p><b>Calibration Lab Technician</b></p> <p><b>Quality Manager</b></p>

Drivers: ISO 9000, 17025, ANSI-Z540, Accreditation.

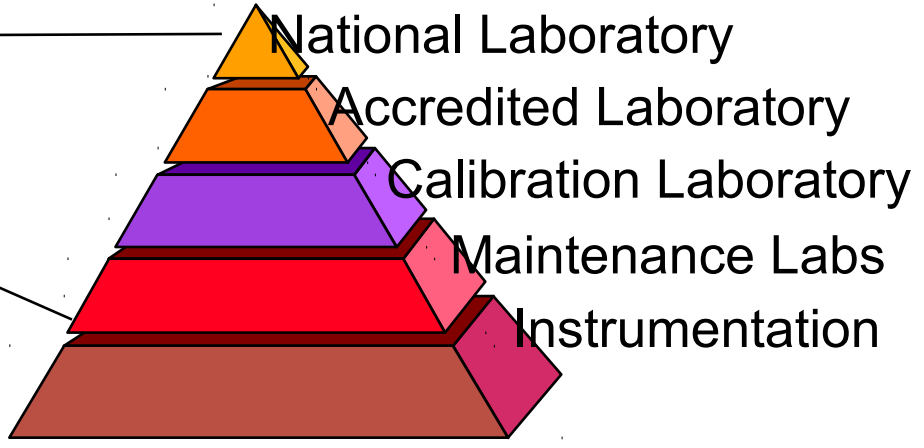
# Electrical Products - Calibrators

**Precision**

**Multi-product**

Fluke 5720A  
Fluke 5700A  
Fluke 57LFC

Fluke 525A  
Fluke 5520A/5500A  
Fluke 5080A/Fluke 9100



DCV Accuracy ± 3.5 ppm  
ACV Accuracy ± 45 ppm  
Ohms Accuracy ± 8.5 ppm  
DCI Accuracy ± 35 ppm  
ACI Accuracy ± 120 ppm



DCV Accuracy ± 7 ppm  
ACV Accuracy ± 75 ppm  
Ohms Accuracy ± 12 ppm  
DCI Accuracy ± 50 ppm  
ACI Accuracy ± 140 ppm



Temperature/Pressure Calibrator



Multi-product performance



**Technology**

- > stability achieved with selected zener diodes
- > thin-film & hermetically sealed Resistors
- > high current amplifier
- > two wire compensation

**Workload**

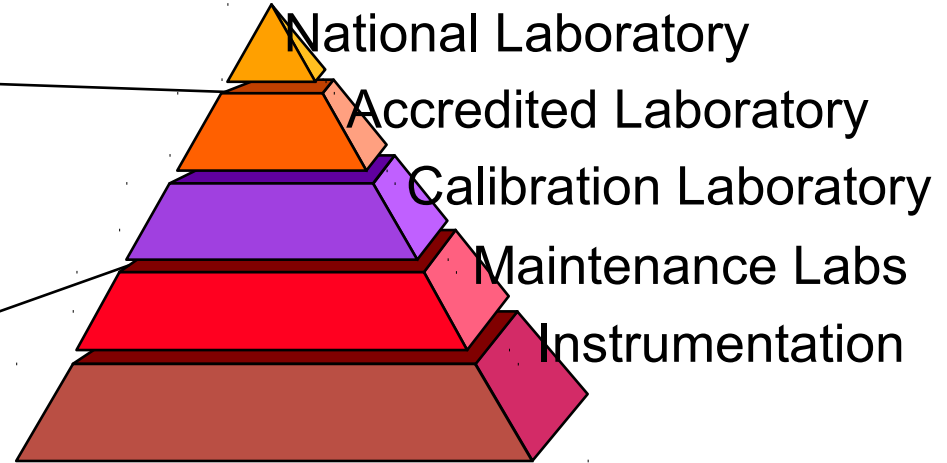
Multimeters to 8½ resolution, clamp meters, scopes, thermometers, power meters, harmonic analyzers, insulation meters

# Electrical Products - Calibrators

**Multifunction Electrical Tester**

**Calibrators**

Fluke 5320A



## Technology

> Active loop compensation

## Workload

- Hipot testers, Insulation resistance testers (megohm meters)
- Loop/Line impedance testers
- Continuity testers, Earth resistance testers, Ground bond testers, Leakage current testers, RCD/GFCI testers, Portable appliance testers & Medical electrical safety testers

# Electrical Products - Oscilloscope Cal

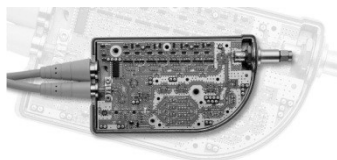
## High Performance

### Oscilloscope Calibrator

Fluke 9500B  
Fluke 5820A



Five channel Active output,  
Leveled sine to 6 GHz



Switched impedance,  
25 ps risetime



## Low Bandwidth

### Oscilloscope Calibrators

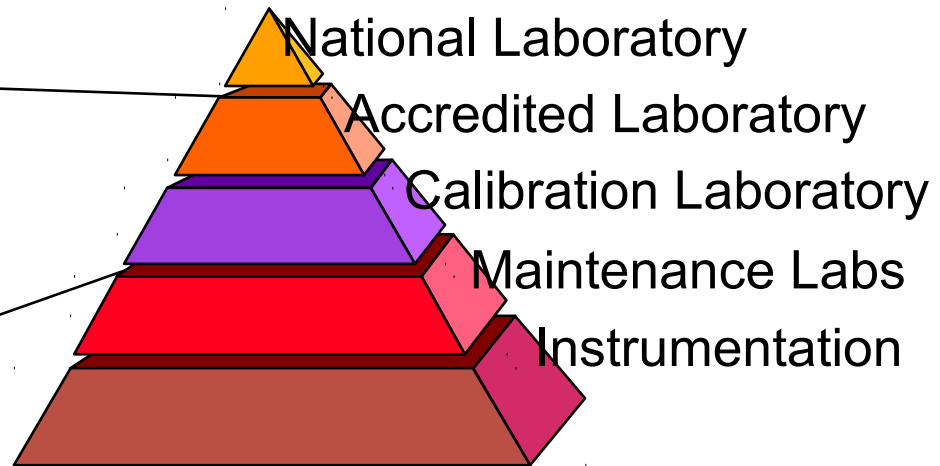
Fluke 5520A/3/6/1GHz  
Fluke 5500A/3/6  
Fluke 9100/250/600



Optional Leveled sine to 1.1 GHz



Time markers, TV trigger,  
300 ps edge



## Technology

- > pin-diode ps pulse technology
- > 6GHz leveling circuits (bandwidth flatness)
- > dual channel phase alignment
- > impedance measurement techniques

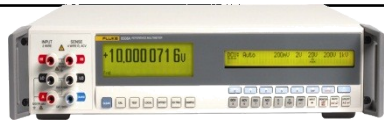
## Workload

- > oscilloscopes - to 14GHz bandwidth
- > frequency/time interval counters



**Precision  
Multimeters**

Fluke 8508A



- 8.5 Digit Resolution
- DCV Accuracy  $\pm 3$  ppm
- ACV Accuracy  $\pm 65$  ppm
- Ohms Accuracy  $\pm 7.5$  ppm
- DCI Accuracy  $\pm 12$  ppm
- ACI Accuracy  $\pm 200$  ppm

**8845A & 8846A**



- 6.5 Digit Resolution
- DCV Accuracy  $\pm 0.0024\%$
- ACV Accuracy  $\pm 0.06\%$
- Ohms Accuracy  $\pm 0.01\%$
- DCI Accuracy  $\pm 0.05\%$
- ACI Accuracy  $\pm 0.1\%$

**8808A**



- 5.5 Digit Resolution
- DCV Accuracy  $\pm 0.015\%$
- ACV Accuracy  $\pm 0.2\%$
- Ohms Accuracy  $\pm 0.02\%$
- DCI Accuracy  $\pm 0.02\%$
- ACI Accuracy  $\pm 0.3\%$

**Temperature/Humidity**

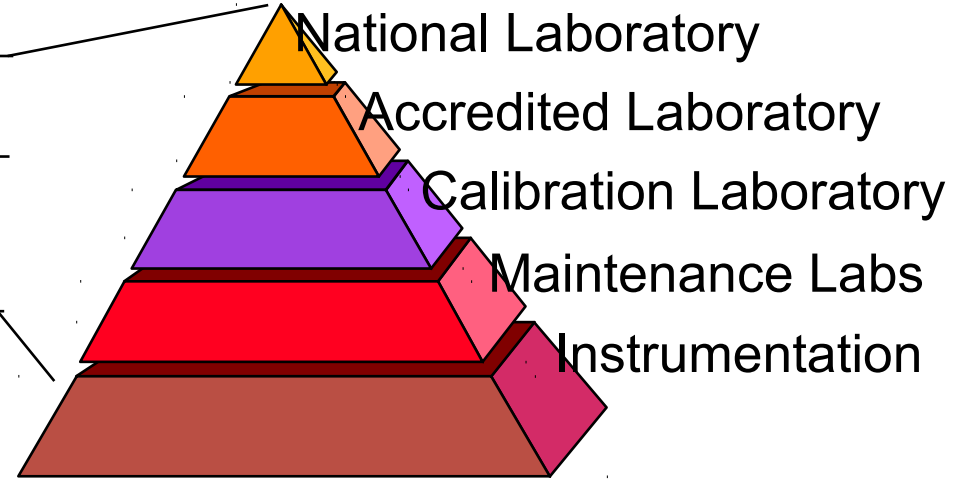
Fluke 1620A  
Fluke 2620T  
Fluke 2635T



Temperature/Humidity sensor



Recording Thermometers



**Technology**

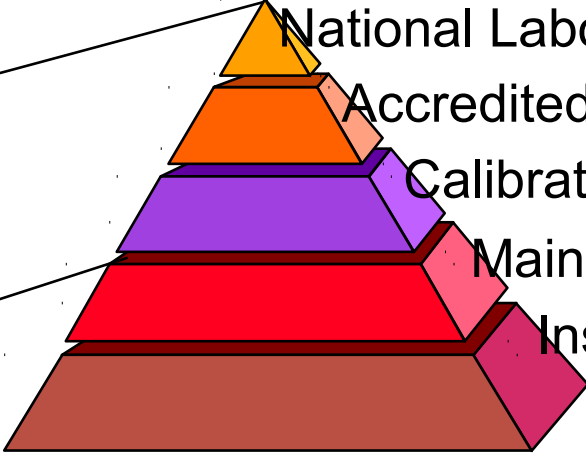




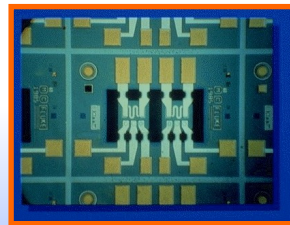

- > selected hermetically sealed resistor ratios
- > low noise buffer amplifiers
- > linear A/D converter
- > switched Ratio measurement

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**Workload**

- > Intercomparison / transfer device
- > power supplies
- > calibrators

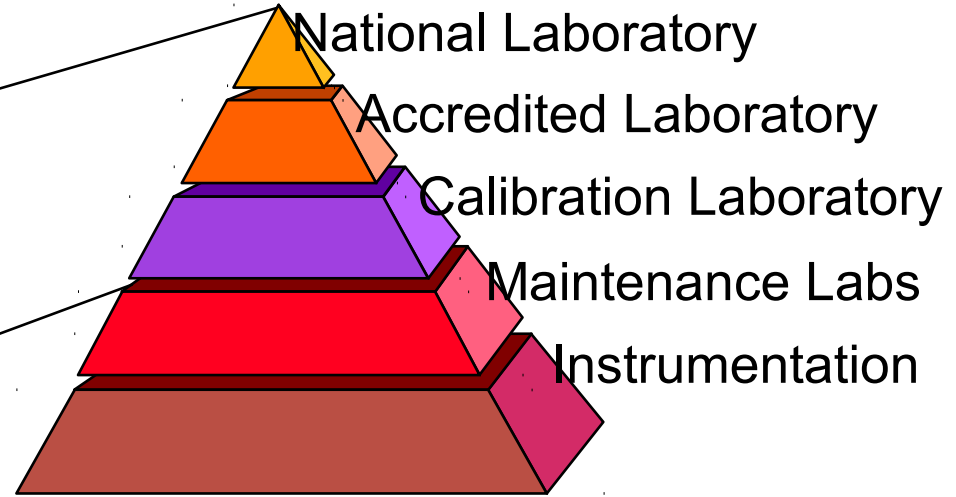
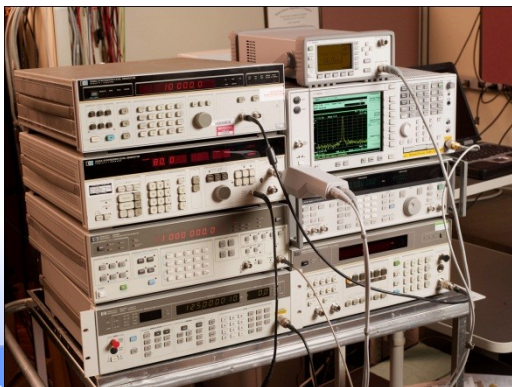
# Electrical Products - Standards

DC Standard	AC/DC Standards		
<p>Fluke 734A/7000 Fluke 720A Fluke A40 Shunts Fluke 732A Resistance Standard</p>	<p>Fluke 792A Fluke 5790A</p>		<p>AC/DC difference <math>\pm 10</math> ppm</p> 
<p>Stability 1.2 ppm/year Predictability 0.2 ppm/year</p>	<p>AC measurement <math>\pm 24</math> ppm</p>		
<p>Stability 1.8 ppm/year Predictability 0.5 ppm/year Fully Automated</p>			<p><b>Technology</b></p> <ul style="list-style-type: none"> <li>&gt; selected zener diodes</li> <li>&gt; selected resistor ratios</li> <li>&gt; dc to dc isolation</li> <li>&gt; automation</li> </ul> <p><b>Workload</b></p> <ul style="list-style-type: none"> <li>&gt; reference and transfer standards</li> <li>&gt; calibrators</li> <li>&gt; laboratory audit standards</li> </ul>

# Electrical Products - RF

## RF Reference Source

Fluke 9640A



### Technology

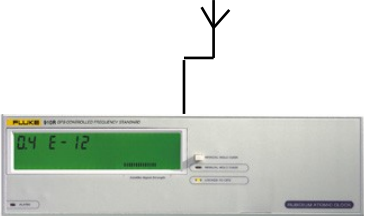

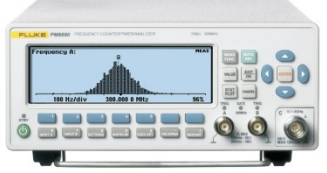


- > A unique combination of level accuracy, dynamic range and frequency in a single instrument
- > High signal purity
- > Precision leveling head minimizes mismatch errors
- > HP3335A command emulation

### Workload




- > Spectrum analyzers
- > Modulation meters and analyzers
- > RF power meters and sensors
- > Measurement receivers, Frequency counters and attenuators

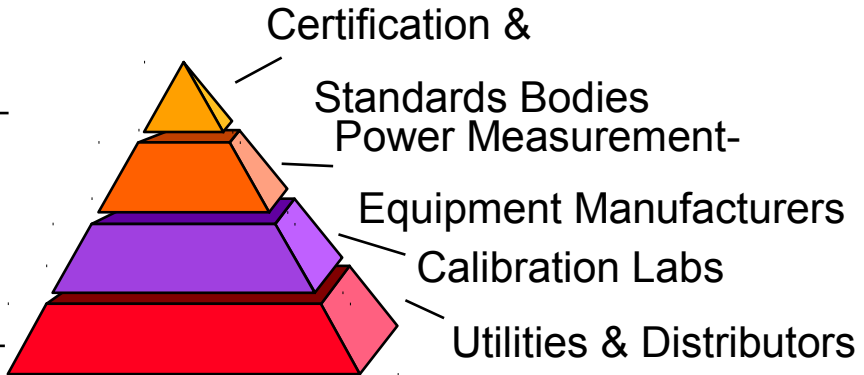
# Electrical Products - Frequency



GPS Frequency Standard	Universal Frequency Counters	
<p>Fluke 910R Fluke 910</p>	<p>Fluke 6681R Fluke 6685R Fluke 908/909 Fluke 6690</p>	
 <p>Fully traceable ultra stable GPS-disciplined frequency references, Rubidium or TCXO</p>  <p>10/5/1/0.1 MHz, Stability <math>1 \times 10^{-12}</math></p>	 <p>12 digits/s frequency measurements Frequency range: 300 MHz standard; 3 GHz or 8 GHz C-channel inputs optional</p>  <p>2.7 GHz, Accuracy <math>2 \times 10^{-10}</math></p>  <p>10/5 MHz, Accuracy <math>5 \times 10^{-12}</math></p>	<p><b>Technology</b></p> <ul style="list-style-type: none"> <li>&gt; cesium-controlled GPS disciplined oscillators</li> <li>&gt; NIST traceable via web based correction data</li> <li>&gt; TimeView statistical analysis software</li> <li>&gt; Ethernet Interface</li> </ul> <p><b>Workload</b></p> <ul style="list-style-type: none"> <li>&gt; frequency/time interval counters</li> <li>&gt; synthesizers</li> <li>&gt; synchronization for ATE system clocks</li> <li>&gt; laboratory time standard</li> </ul>

# Electrical - Power Standards

Multi-phase Electrical Power Standard	Single Phase Power Quality
Fluke 6100B Fluke 6105A Optional of 80A and Energy Option	Fluke 5520A
	
Master Single phase output with control of up to three additional phases (80A and Energy Option shown)	Single phase Power Quality Option
	
Auxiliary phases -the system can support a maximum of four phases	



**Technology**

- > High compliance single or multiphase,
- > traceable sine and non-sine stimulus
- > generates harmonic & interharmonic signals
- > simultaneous output of different signal types

**Workload**

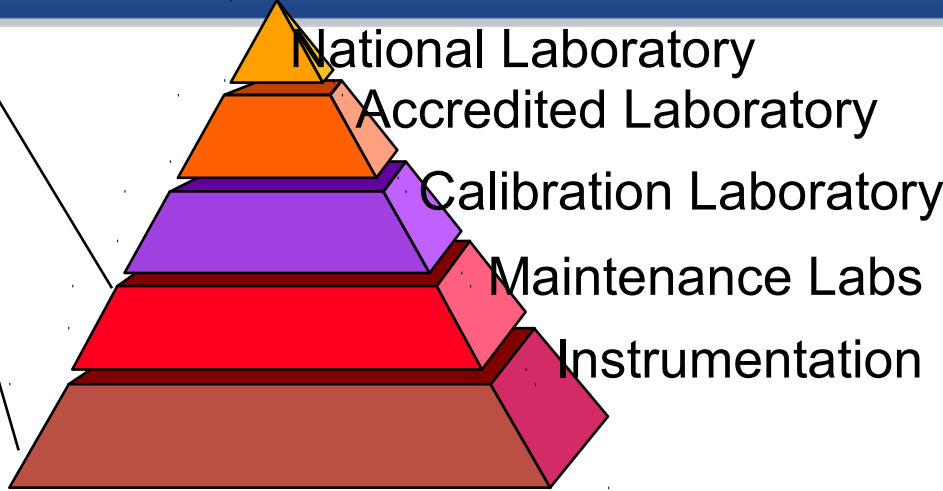
- > Power measuring instruments
- > Power protective relays
- > harmonic correctors
- > tests compliance to IEC 61000-4-30

**Universal Signal Sources**

Model 397  
 Model 396  
 Model 281/282/284

**Signal Generators**

Model 80/81  
 Model 271



- 125 MS/s Arbitrary Waveform Generator
- High resolution 50MHz



- 40 MS/s Universal Waveform Generator
- 1, 2 or 4 Channels
- Inter Channel Phase Locking



10MHz DSS Function Generator



50 MHz waveform generators

**Technology**

- > fast sampling D/A converters
- > direct digital synthesis
- > low distortion output

**Workload**

- > research/education
- > pace-maker simulation
- > anti-lock brake test systems
- > ATE applications

# Multi - Channel Measurement

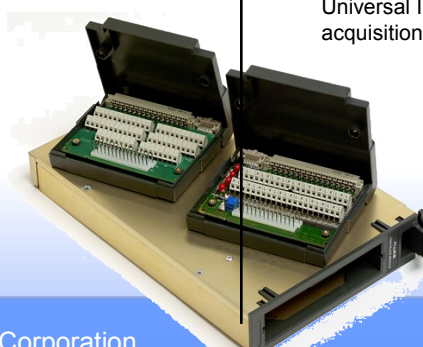
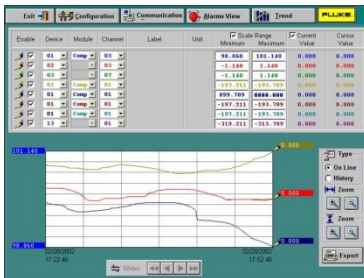
**High speed & channel count**

Fluke 2680A

Fluke 2686A



High speed, 120 channel acquisition unit, Ethernet, 1000rps



**Portable Multi-channel Measurement**

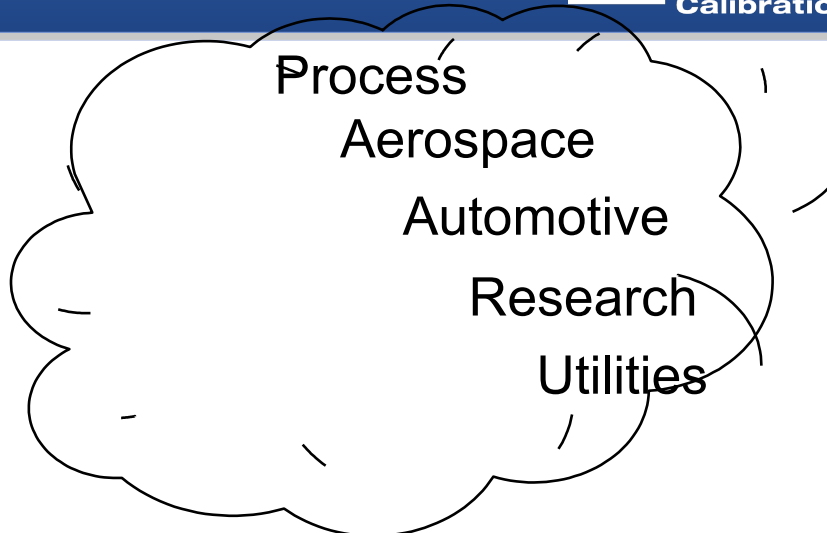
Fluke Hydra  
NetDAQ



High speed multi-channel measurements, DCV, ACV, Ohms, Freq., RTD.



Universal Inputs, Real-time acquisition



## Technology

- > high speed switching
- > battery operated
- > precision thermocouple measurement
- > wide area Ethernet connectivity

## Workload

- > applications are infinite



**FLUKE**®



**Hart Scientific**®

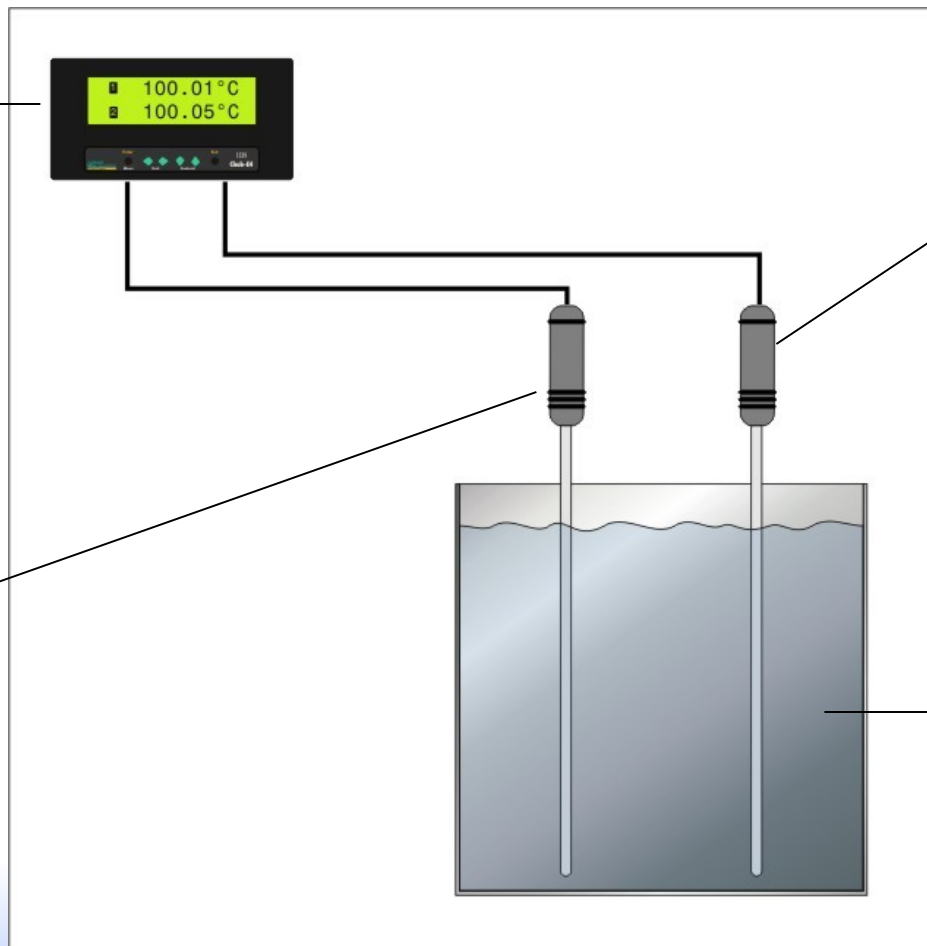


**HART  
SCIENTIFIC**



# What is Temp Cal?

Thermometer  
Readouts

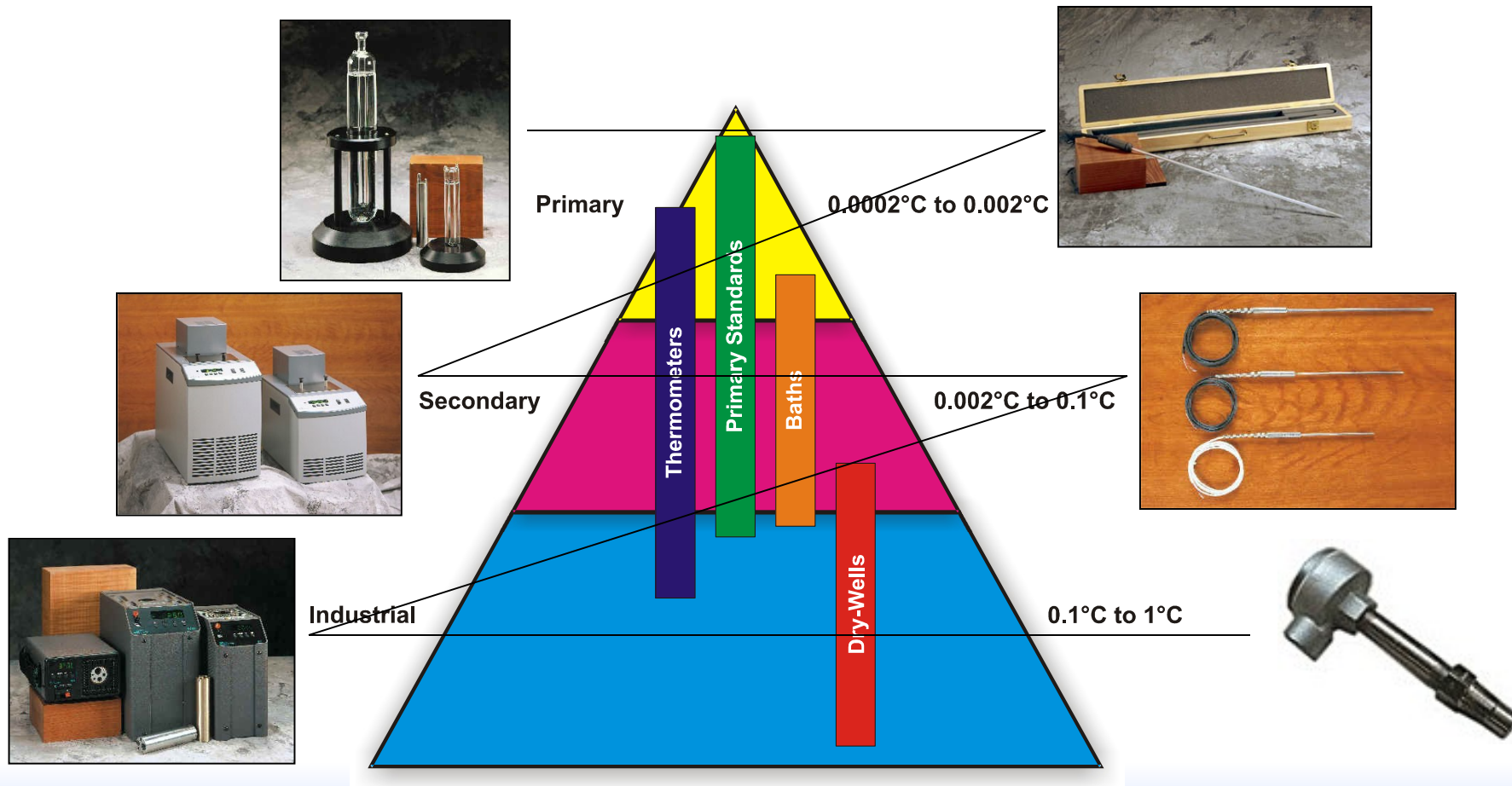


Reference  
Thermometers  
(Primary Stds)

Basic temperature  
sensors being  
tested (we don't  
make)

Fluid Baths  
Dry-Wells  
Fixed-Point Cells  
(Primary Stds)

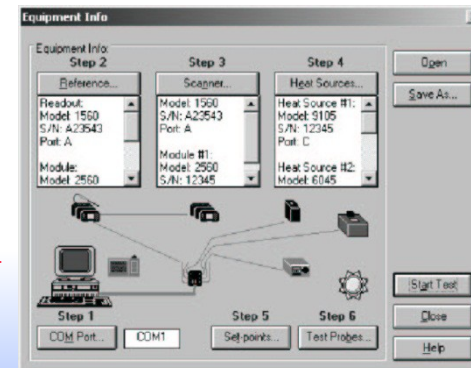
# Customers



- Four Major **Product Lines**
  - Primary Standards (ITS-90 SPRT ranges)
  - Contact Thermometer Readouts & Reference Thermometers
  - Industrial (dry-wells, Micro-Baths, IR Blackbodies, etc.)
  - Fluid Baths
- Three Major **Customer Segments**
  - Primary Labs - Realizing the ITS-90 thru SPRTs
  - Secondary Labs – Transferring the ITS-90 thru SPRTs and “comparison”
  - Industrial– Checking industrial probes with inexpensive, simple standards
- Wide Variety of **Industries**
  - National labs, government, and defense
  - Pharmaceuticals, semi-con, power, gas, oceans, foods, etc.
  - Third-party labs in multiple metrology disciplines
  - Temperature sensor manufacturers

- National Labs
- Corporate Cal Labs (primary, secondary, and industrial)
- Independent Cal Labs
- Other Metrology Disciplines (mass, dimension, electrical)
- Temperature Sensor Manufacturers
- Defense & Government
- Industry (semi-con, power, gas, oil, pharmaceuticals, oceans, etc.)
- Thermometry and Research

- Primary Standards
- Thermometer Readouts for resistance & voltage
- Temperature Baths (fluid)
- Industrial Calibrators (including IR blackbodies)
- Software



- TPW Cells – five sizes, shapes—even for industrial applications!
- ITS-90 Fixed-Point Cells – from mercury to copper
- SPRTs – quartz, metal, high-stability, low-temp, etc.
- Maintenance Apparatus – baths, furnaces

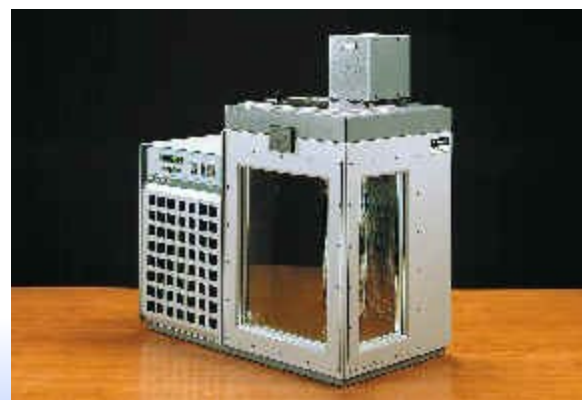


- Reference Readouts – Super-Thermometers, *Black Stack*, Chub-E4, etc. (0.8 to 25 ppm)
- Portable and Handheld References – Tweeners, 1523, 1524
- Reference Sensors – secondary PRTs, thermistors, noble-metal TCs



# Temperature Baths

- Standard Baths – to  $\pm 0.0008$  from  $-100^{\circ}\text{C}$  to  $550^{\circ}\text{C}$
- Compact Baths – to  $\pm 0.005$  from  $-80^{\circ}\text{C}$  to  $300^{\circ}\text{C}$
- Resistor Baths – to  $\pm 0.0007$  from  $0^{\circ}\text{C}$  to  $100^{\circ}\text{C}$
- Special Application Baths – windows, custom sizes, LIGTs, oceanographic, infrared, etc.





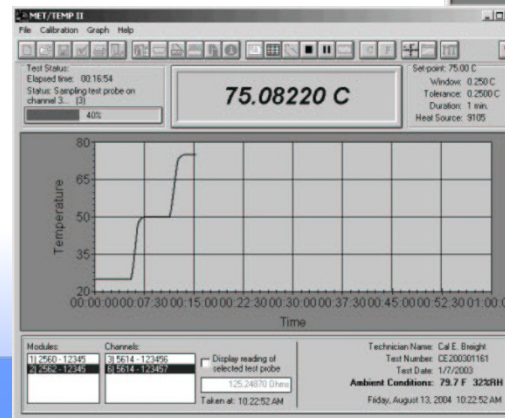
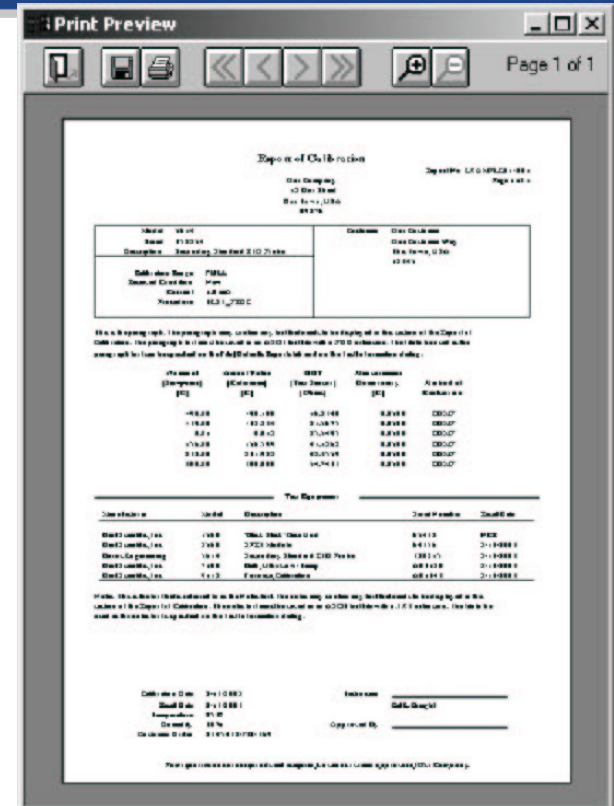
# Industrial Calibrators

- Lab Dry-Wells – to  $\pm 0.005^{\circ}\text{C}$ !  
from  $-45^{\circ}\text{C}$  to  $600^{\circ}\text{C}$
- Field Metrology Wells –  
performance, portability, and  
speed
- Handheld Dry-Wells – unmatched  
entry-level temp calibration tools
- Micro-Baths – all the best  
features of baths and dry-wells
- IR Blackbody – Large Target Size  
with Radiometric Calibration  
Traceability



# Software and Systems

- *Interface-it* – free heat source Windows interface
- MET/TEMP II – complete systems calibration automation package
- *TableWare* – creates probe constants and R-vs-T reference tables to ITS-90 or other conversions
- *LogWare* – data-logging and analysis package

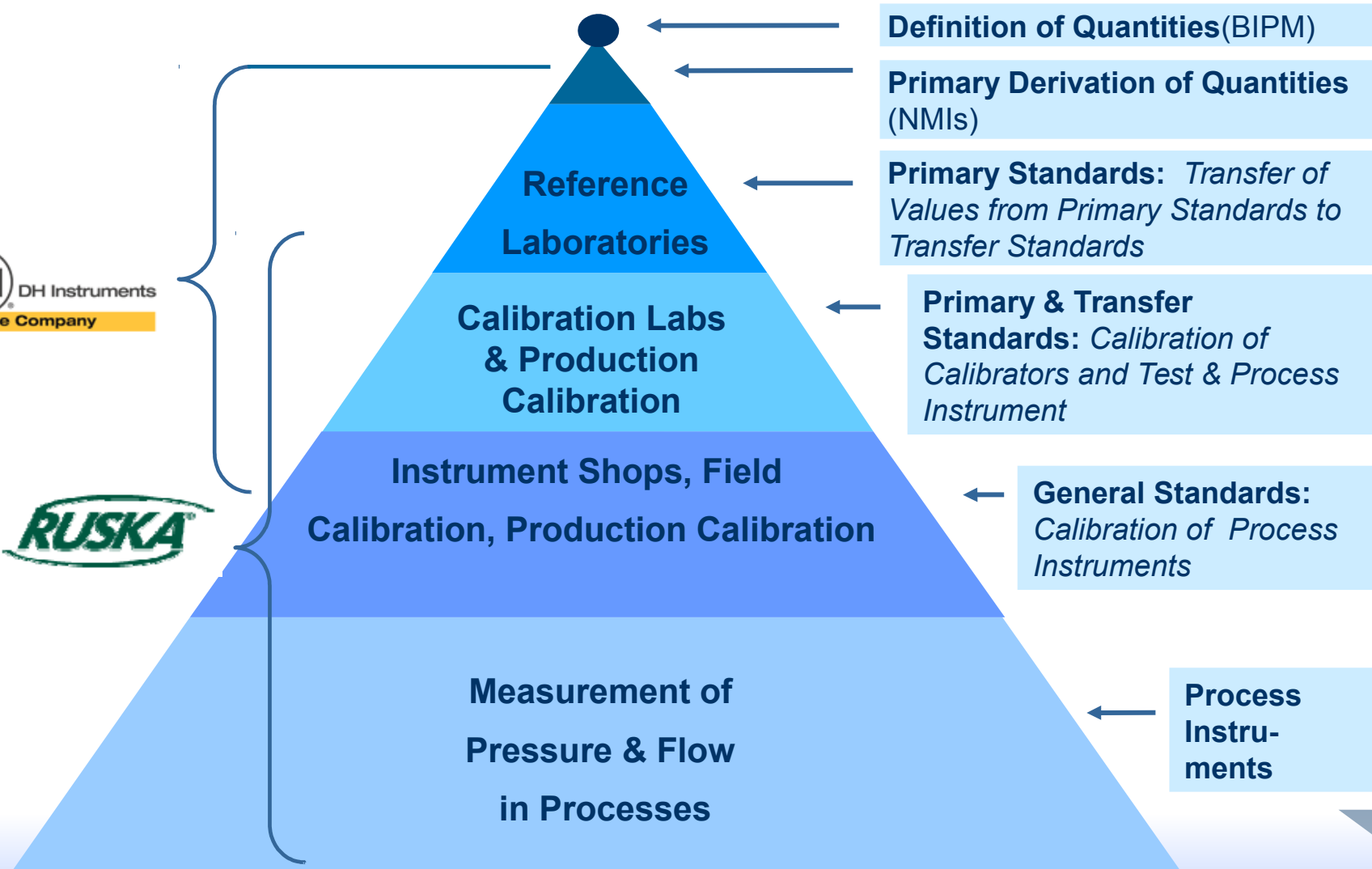


# Services

- Accredited Lab – one of the best in the commercial world (NVLAP, UKAS & SINGLAS)
- Training – temperature calibration and product training at Hart school



**Hart Scientific is the only Temperature Products Manufacturer in the world that have 3 labs in the world that are Accredited.**



Definition of Quantities(BIPM)

Primary Derivation of Quantities (NMIs)

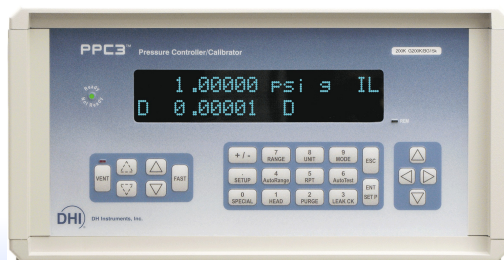
Primary Standards: *Transfer of Values from Primary Standards to Transfer Standards*

Primary & Transfer Standards: *Calibration of Calibrators and Test & Process Instrument*

General Standards: *Calibration of Process Instruments*

Process Instruments

- Primary Standards
  - FPG8601, PG 7601, PG 7102, PG 7202 & PG 7302
- Transfer Standards
  - RPM4, PPC-3, PPCH & PPCH-G
- Accessories
- Calibration Software

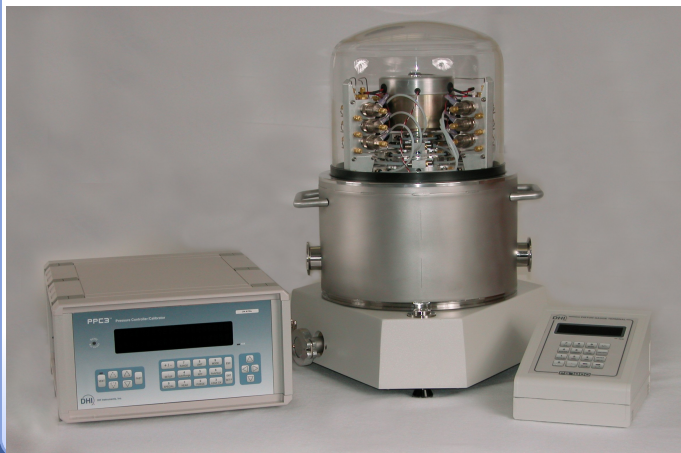
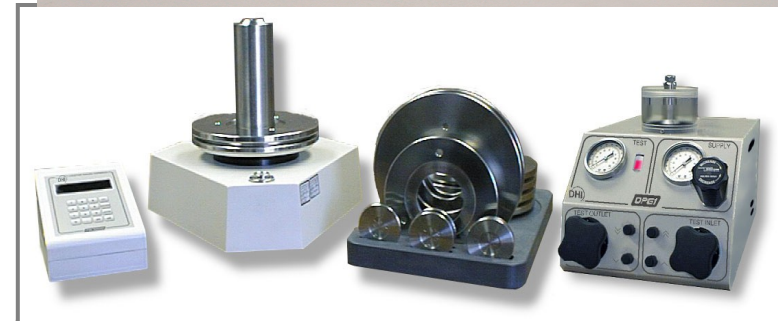
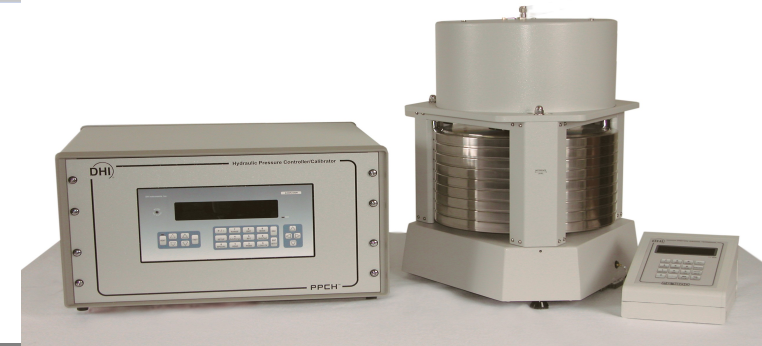


# Primary Standard

**FLUKE**®

Calibration

- FPG8601
- PG7601
- PG7102
- PG7202
- PG7302



## PG-7102



- Operating Range : 4KPa to 7MPa
- Operate in Gas for Gauge mode only
- a manual or automated controller can be used to float the piston-cylinder
- Mass set of 35/40/45/55Kg selection
- Piston Cylinder of 10/20/50/100/200 KPa/Kg
- Can be used with AMH-38/100 for full automation.

# DHI Fundamental Standards

## PG-7202



- Operating Range : 100 KPa to 110MPa
- Operate in Gas and liquid lubricated PC for Gauge mode only
- manual or automated controller can be used to float the piston-cylinder
- Can also be used for some hydraulic applications to provide a more versatile solution
- Mass set of 35/40/45/55Kg selection
- Piston Cylinder of 100/200/500 KPa/Kg or 1/2 MPa/Kg
- Can be used with AMH-38/100 for full automation.



# DHI Fundamental Standards

## PG-7302

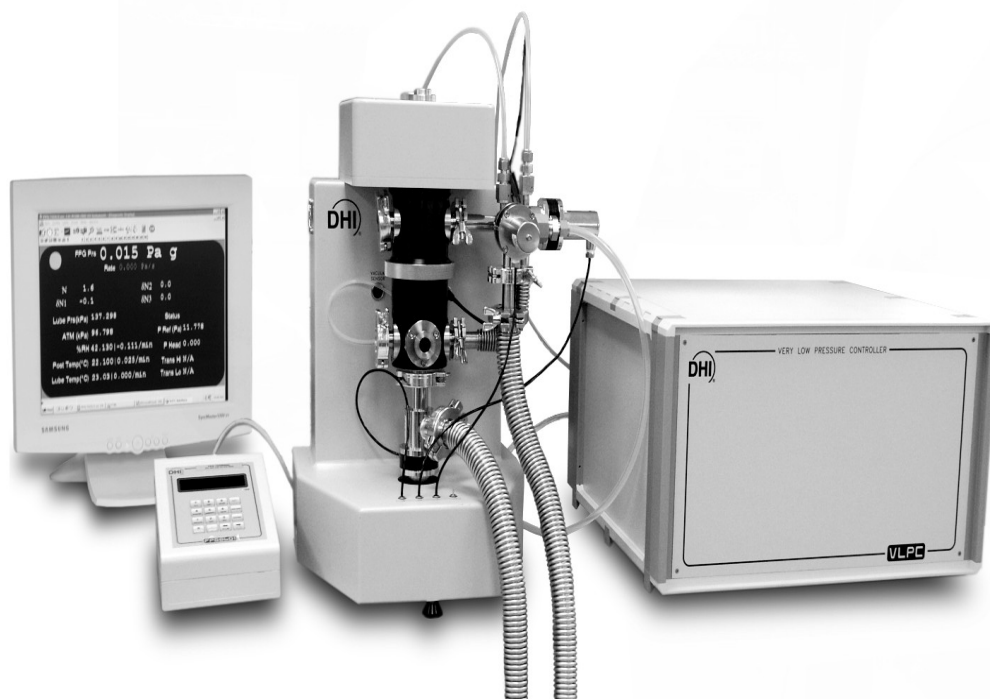


- Operating Range : 100 KPa to 500 MPa
- Operate in oil for Gauge mode only
- manual or automated controller can be used to float the piston-cylinder
- Mass set of 35/40/45/55/80/100 Kg selection
- Piston Cylinder of 100/200/500 KPa/Kg or 1/2/5 MPa/Kg

Can be used with AMH-100 for full automation.

# DHI Fundamental Standards

## FPG-8601 (Force Piston Gauge)



- Force Balance Piston Gauge covering the very low range from about 1 Pa (0.015 psi ) up to 15 kPa (2.2 psi)
- Measures both gauge and absolute pressures
- Is a complete system including VLPC pressure controller and PC based software to calculate pressure and run automated tests
- No other system on the market realistically competes with this specialized product

# Ruska Piston Gauge Overview

## Core Technical Competency

Instrumentation Design

Piston/Cylinder Lapping

Pressure Metrology

Product breadth

NVLAP Accredited to ISO 17025

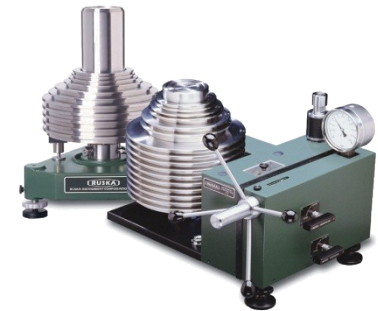
ISO 9001 Accredited



Pneumatic Standard  
0.0010% of reading for pressures to 100 psi (7 bar), 0.0027% of Reading to 1000 psi (70 bar)



High Line Differential Pressure standard  
Pneumatic and Hydraulic Differential Pressure Calibrations to 850 inH2O (2100 mbar) at line pressures up to 2900 psi (200 bar)



Hydraulic Standards  
10 to 72,500 psig  
0.003% of reading



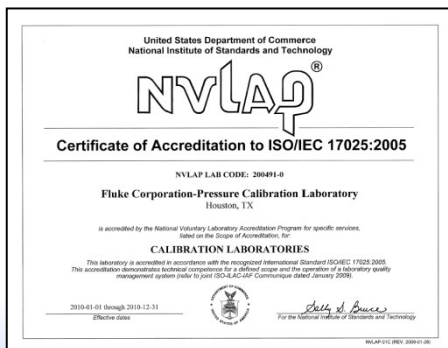
High Pressure Pneumatic Standard  
0.2 to 3000 psig with an accuracy of 0.0010% of reading to 100 psig and 0.0025% of reading to 3000 psig



Media separator  
5 part per million uncertainty



Piston Gauge monitor and WinPrompt software enhance measurement parameters by measuring and correcting for piston temperature, float position, sink rate, air density, vacuum and other variables



# 2465 Pneumatic Piston Gauge

- Range: 0.2 - 1000 psi (1.37 kPa to 6.7 MPa)
- Mode: Gauge, Absolute, Neg. gauge, and Simulated Abs.
- Range/Uncertainty:
  - 0.2 - 25 psi (1.37 - 170 kPa): 10 ppm
  - 1.7 - 100 psi (11 - 690 kPa): 10 ppm
  - 2 - 500 psi (13.8 kPa - 3.4 MPa) 26 ppm
  - 2 - 1000 psi (13.8 kPa - 6.7 MPa) 26 ppm
- Long Term Stability: 1 ppm per year
- WinPrompt® Software: Measures and corrects for Float Position, P/C Temp., Amb (Temperature, Humidity, Pressure), etc.
- Autofloat Controller: Maintain within float range indefinitely
- Over 2000 units sold world wide



# 2485 Hydraulic Piston Gauge

- Total Uncertainty and Pressure Range:
  - 10 - 1,000 psi (0.5 – 50 bar) Greater of 25 ppm or 14 Pa
  - 100 - 10,000 psi (5 – 500 bar) 35 ppm
  - 200 - 20,000 psi (10 – 1,000 bar) 35 ppm
  - 1,000 - 72,500 psi (75 – 5,000 bar) 100 ppm
- Cemented Tungsten Carbide Piston Cylinders
  - 1 ppm of Reading reproducibility
- Two Bases Available
  - Low Range: 20,000 psi (1400 bar)
  - High Range: 72,500 psi (5000 bar)
- Integrated Pressure Generation system



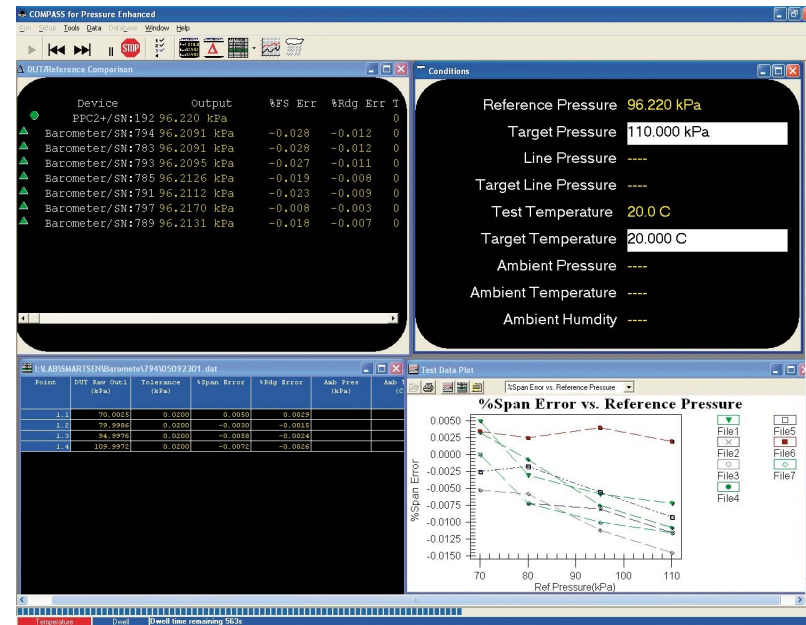
# 2482 Differential Piston Gauge

- Primary Standard for Differential Pressure Calibrations at Elevated Line Pressures
- Total Uncertainty: 40 ppm  $\Delta p$  + 0.04 inH<sub>2</sub>O (9 Pa)
- Quick and Very Simple to Operate
- Line pressure to 2900 psi (20 MPa)
- Differentials to 850 inH<sub>2</sub>O (210 kPa)
- Automated control with WinPrompt®
- Differential Thermal Control
- Hydraulic/Pneumatic Media

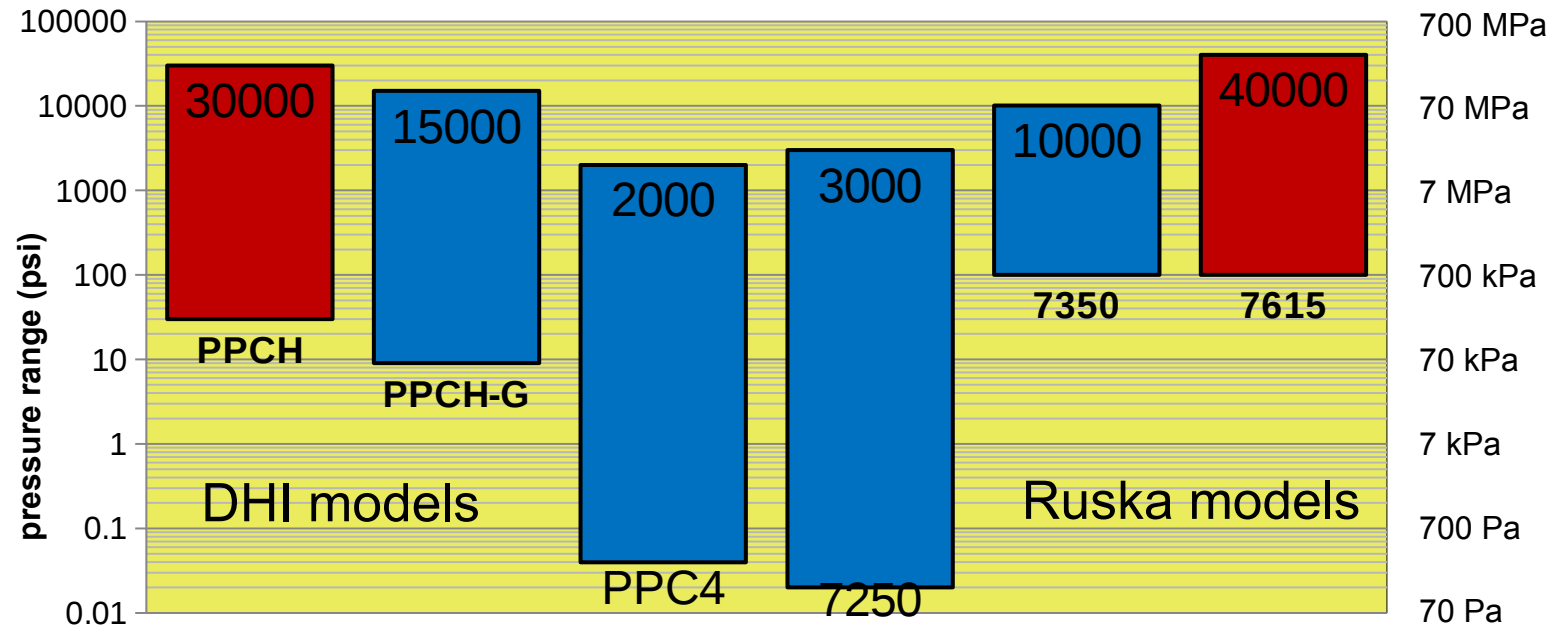


## COMPASS for Pressure

COMPASS for Pressure provides the tool to automate your pressure calibrations. It improves throughput and enhances the quality of the calibration data.



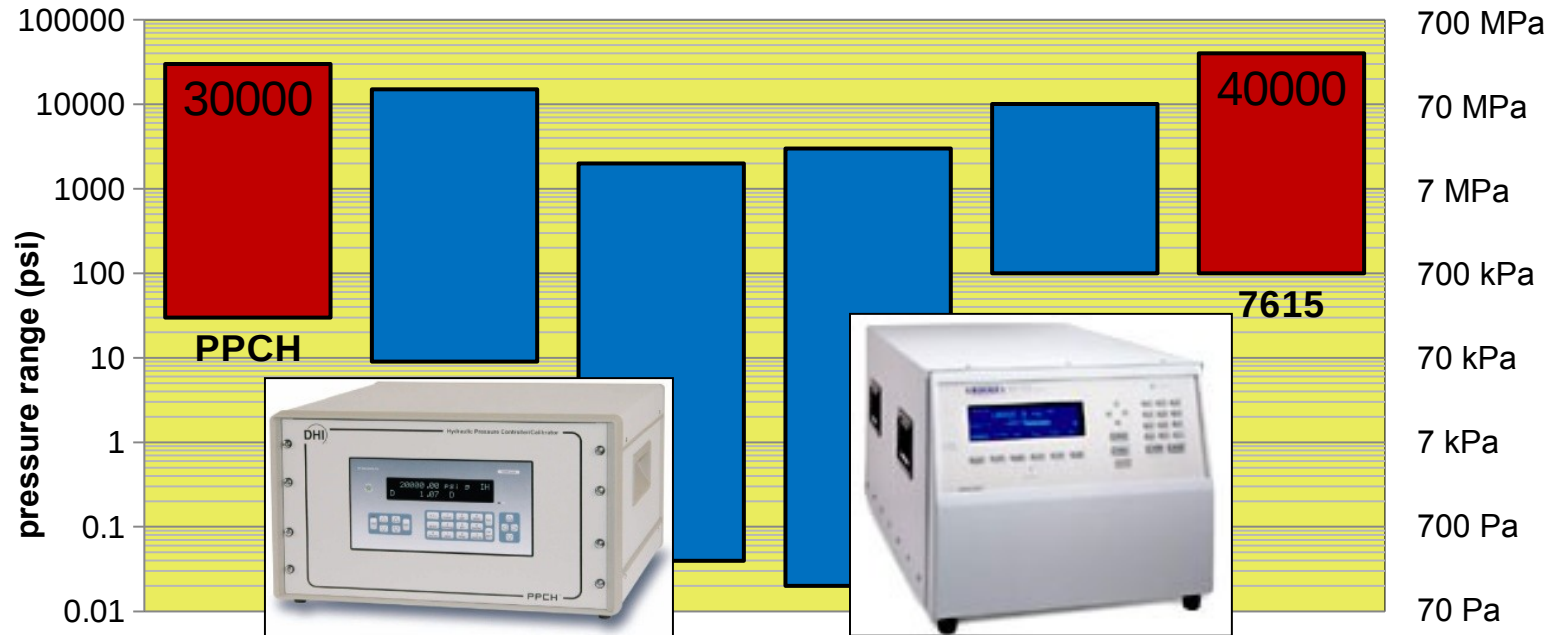
# Fluke-Calibration Pressure Controllers



- With the addition of Ruska products, Fluke Calibration now offers a wide range of pressure controller/calibrators, better covering all applications.



# Hydraulic Pressure Controllers



## DHI PPCH

- Excellent control precision and measurement across a wide range
- Available with modular external pressure measurement with RPM4
- Floats PG7302 Piston Gauges for Automation

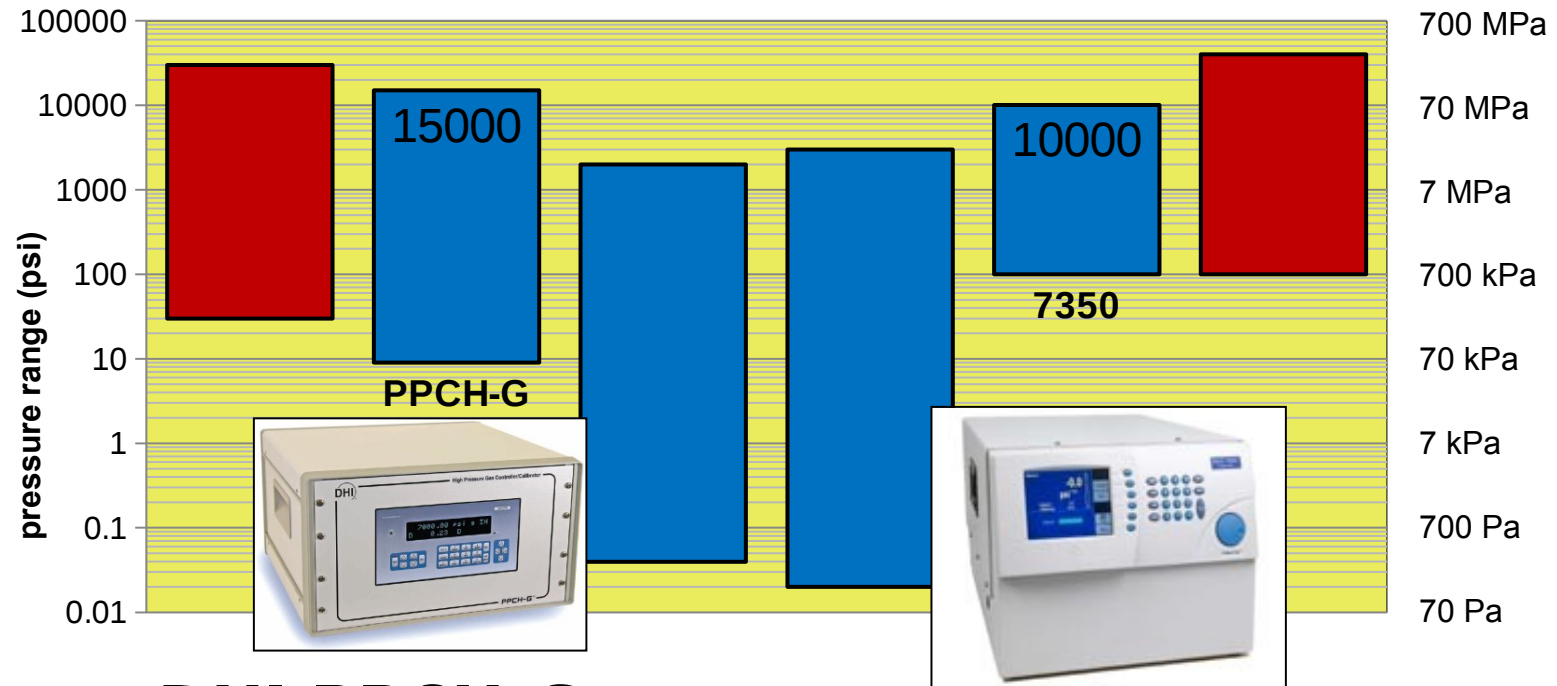
## Ruska 7615

- Fast, High Volume Control (ideal for manufacturing and test)
- Able to use water and a very wide variety of liquids
- Ranges as high as 40k psi (280 MPa)

# High Pressure Gas Pressure Controllers

FLUKE®

Calibration



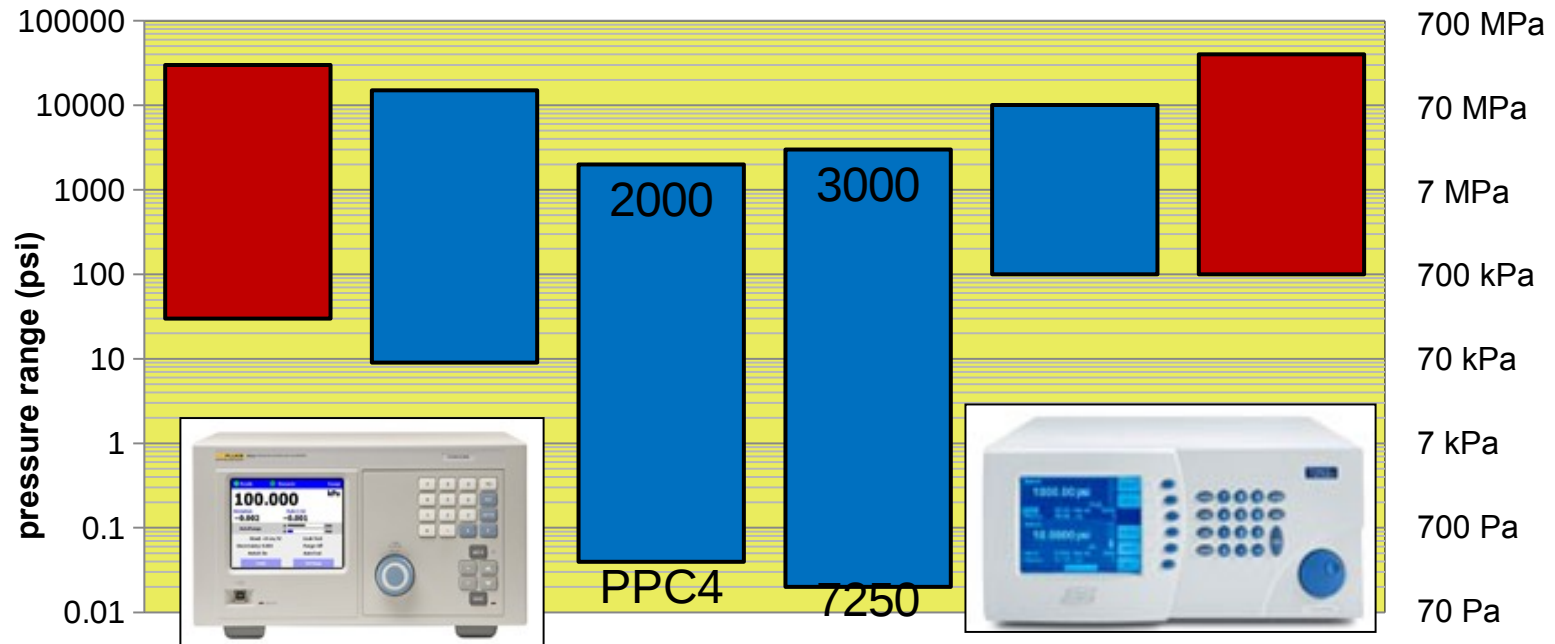
## DHI PPCH-G

- Excellent control precision and measurement across a wide range to 15k psi (100 MPa)
- Available with modular external pressure measurement with RPM4
- Floats PG7202 Piston Gauges

## Ruska 7350

- Fast, High Volume Dual Stage Control (ideal for manufacturing and test)
- Ranges as high as 10k psi (70 MPa)
- Graphical user interface

# Gas Pressure Controllers



## DHI PPC4

- Excellent control precision and measurement across a wide range
- Available with modular external pressure measurement with RPM4
- Floats PG7000 Gas Piston Gauges
- Small and robust, can be transported

## Ruska 7250, 7252

- Fast Control (ideal for manufacturing and test)
- Quartz Bourdon Tube offers unequalled intrinsic measurement
- Dual channel controller available with 7252
- Ranges as high as 3k psi (20 MPa)
- Excellent measurement at low P with 7250LP

# Introducing PPC4E

- **Wide Range, 0.02% Controller/Calibrator**  
Designed to cover a wide range of everyday workload, to maximize return on investment
- Controls pressure over the absolute range of **1 kPa (0.15 psi) to 14 MPa (2,000 psi)** and gauge equivalent, including low differential pressures
- Up to **100:1** accurate measure and control range turndown can truly be realized by a single calibrator
- Switch between **absolute, gauge and bidirectional gauge modes** and meet full-year measurement specifications without added hardware or special calibration or maintenance operations



# PPC4E Features

FLUKE®

Calibration

- Standard color graphical user interface with full support in 11 languages
- RS-232 and IEEE-488.2 remote interfaces included. Valve drivers built-in for ATE system design
- AutoRange feature optimizes and sets measurement, control and safety features for specific range of the test being run with a few simple entries
- Measurement uncertainty is calculated real-time and displayed in the current pressure units
- On-board, programmable calibration sequences and leak testing routines
- Set point jog feature to quickly perform cardinal point calibrations of analog gauges
- Self purging liquid trap accessory available to automatically protect PPC4E from system contamination



# The Power of Rangeability

- PPC4E measurement compared to typical devices in the same performance class

UUT Range		± 0.02 % of AutoRanged span		± 0.01 % of reading from 50 % to 100 % of each sensor		± (0.005 % FS + 0.005 % Rdg) precision, each sensor, with ± 0.01 % Rdg 1 yr stability	
kPa	psi	PPC4E 7M AutoRange down to 10 % FS	PPC4EX 7M AutoRange down to 1 % FS	With 2 sensors: 1000 psi and 500 psi (7 and 3.5 MPa)	With 4 sensors: 1000 psi, 500 psi, 250 psi, 125 psi (7, 3.5, 1.7, .9 MPa)	With 1 sensor: 1000 psi (7 MPa)	With 2 sensors: 1000 and 500 psi (7 and 3.5 MPa)
7000	1000						
5500	800						
4100	600						
2750	400						
1400	200					-	
700	100					-	-
550	80			-		-	-
410	60	-		-		-	-
275	40	-		-		-	-
140	20	-		-	-	-	-
70	10	-		-	-	-	-
55	8	-		-	-	-	-

## Pressurements



*Hydraulic – Oil or Water*



*Pneumatic – Positive or Negative Gauge*



*High Pressure*

## DH Instruments



*Electronic type – Hydraulic Oil or Water*



*Our endorsement of  
commitment in to  
Industrial / General  
level of Calibration*

# Decoding the Model Number

**0 = Gas**

**1 = Single Piston/Cylinder**

**1 = Oil**

**2 = Dual Piston/Cylinder**

**2 = Water**

**3 = Liquid Lubricated Gas Piston/Cylinder**

**P3XXX-X-P ← P = Built in Pump**

**Pressure Range**

**Nominal Units**



# P3100/P3200 Series Hydraulic DWT

- Ranges up to 20,000 Psi (1400 bar)
- 0.015% accuracy standard, 0.008% optional
- Small compact and lightweight (Transportable)
- Integrated pressure generation and control
- Easy installation of DUT (Wrenches and Teflon tape free)
- Cost effective



# P3000 Pneumatic

- Ranges from vacuum thru 2000 psi (140 bar)
- 0.015% accuracy standard, 0.008% optional
- Dual vacuum/pressure models available
- Gas operated with optional hand pumps
- Psi, bar, kgf/cm<sup>2</sup>, kPa and MPa ranges



- Piston/cylinder design
- Mounted spirit level with adjustable feet
- High quality needle valves provide optimum control
- Piston flotation indicator

# Vacuum and Dual Vacuum/Pressure Models

FLUKE®

Calibration



- Pressure ranges from 5 inH<sub>2</sub>O (15 mbar) thru 500 psi (35 bar)
- Connection for external source (pressure/vacuum) or built-in hand pump option
- Selector valve for easy crossover from pressure to vacuum
- Series 3 non-magnetic stainless steel weights

***0.015% accuracy standard, 0.008% optional***

- High Pressure DWT
  - Three ranges available, 30,000, 40,000, or 60,000 psi (2000, 2500 or 4000 bar)
- Accuracy (0.02% or 0.015%)
- Test Port Adapters include Autoclave, 3/8 BSP, 1/2 BSP, & 3/4 BSP



## ***E-DWT Features***



- Operator always knows the pressure
- One or two reference sensors
- For pressures up to 30 000 psi
- Uncertainty of +/- 0.025% of reading to 10% of each range
- Two reference sensors gives +/- 0.025% reading from 1 to 100% of E-DWT range
- Unlimited pressure control resolution
- Transportable – Battery option for 8 hours of field operation
- Very lightweight package for easy movement.
- No need to ship masses away for regular calibrations
- System provides Ready/Not Ready indication based on stability
- Electronic output allows for automated data collection using calibration software.

## ***E-DWT Benefits***



- Not possible to have 'wrong' reference pressure
- Can adjust pressure to where you want
- Easy to set each test pressure
- Low uncertainty allows for calibrating more accurate instruments like transducers and deadweight testers
- With software, automated data collection eliminates errors
- With battery, can be used remotely all day without the need for external power

## DHI Accessories

- GB
- GB-H-152
- GPC1-16000
- OPG1
- MPC1
- MPG2
- Other

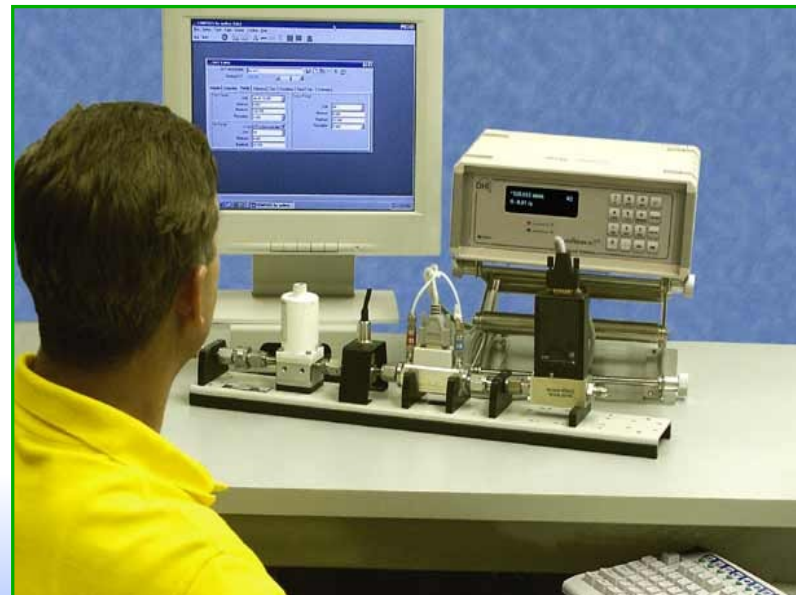
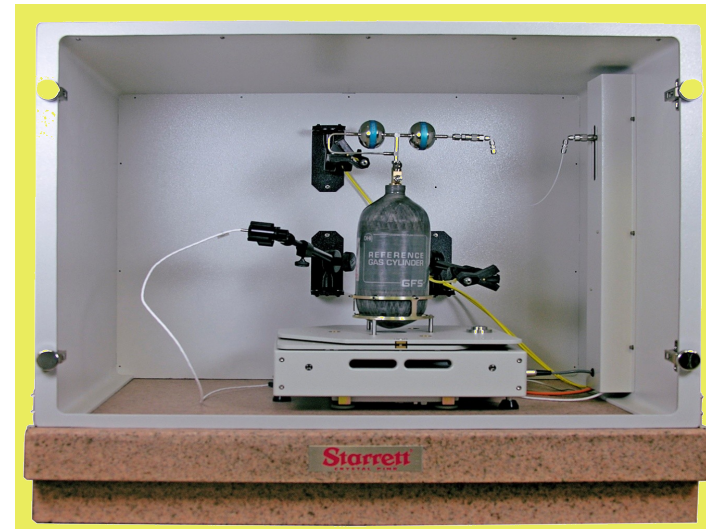


## Pressurement Accessories

- P5514 / P5515
- P5521 / P5522
- Adaptors two gauge Stands

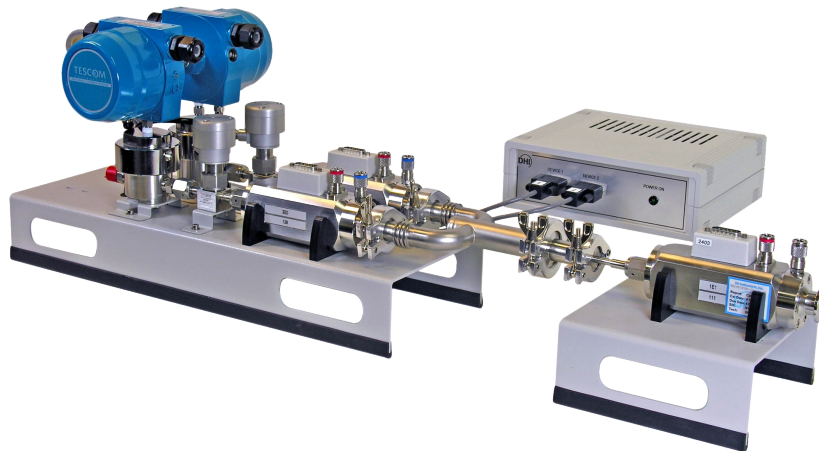


- **Primary Standards**
  - GFS-2012 & Successive Addition
- **Transfer Standards**
  - Molbox1, molbloc-L & molbloc-S
- **Accessories**
- **Calibration Software**





- GFS-2102
  - 10sccm to 10slm
  - Compatible with all molbox gases



- Successive Addition
  - 10 to 5000 slm
  - Compatible with all molbox gases

- molbox1
  - $\pm 0.125\%$  υνχερταιντψ ωιτη μοστ μολβλοχσ
- μολβοξ ΡΦΜ
  - $\pm 0.5\%$  υνχερταιντψ ωιτη αλλ μολβλοχσ
- μολβλοχ–Λ
  - Λαμιναρ Φλωω Ελεμεντ τεχνηολογψ
  - 1.0 σχχμ το 100 σλμ
- μολβλοχ–Σ
  - Σονιχ Νοζζλε Τεχνηολογψ
  - 10 το 5,000 σλμ

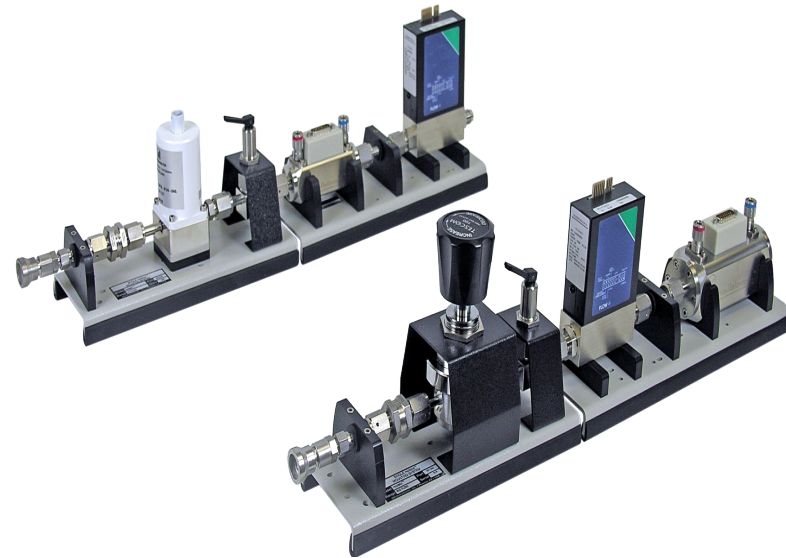


# DHI Flow Products – Accessories

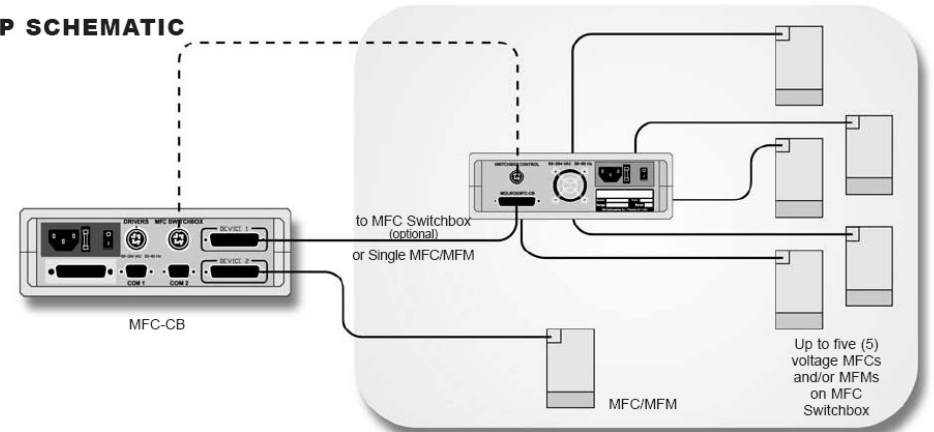
FLUKE®

Calibration

- molstic-L/S
- MFC-CB
- MFC-Switchbox



## SET UP SCHEMATIC



## Maximize the value of your investment in Fluke and Hart Scientific hardware and software

- A full spectrum of practical classes in calibration, thermometry, and metrology — regularly scheduled at convenient locations
- Classes taught by highly-trained professionals
- Comprehensive lectures combined with hands-on experience
- Fast local service and product support
- Strong commitment to customer satisfaction, before and after the sale



**Question????**

Your subject  
photo here





