1462 MODERNIZATION OF THE NATIONAL WEATHER SERVICE STERLING FIELD SUPPORT CENTER LABORATORIES

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Introduction

- Sterling Field Support Center (SFSC): NWS's premier testing facility for Surface and Upper Air observation systems, sensors and consumables
- Facility includes multiple outdoor testbeds for real-time weather data collection, as well as multiple labs for testing and calibration of all types of sensors
- Co-located with the NWS Baltimore/Washington Weather Forecast Office on 220+ acres, adjacent to Dulles International Airport
- SFSC has four labs: pressure, hygrothermometer, environmental chambers, and wind tunnel
- Concerted effort has been made over the past two to three years to upgrade all labs to current standards
- SFSC is investigating the potential of becoming a WMO Regional Instrument Centre (RIC).
- RICs assist members of the WMO region in calibrating their national meteorological standards and related environmental monitoring instruments for the following variables: temperature, humidity, pressure and possibly others.

Figure 1 SFSC Main Building

Pressure Lab

Need for Modernization

- Originally contained a Hass MS-3 mercury manometer as its primary standard
- January 2013 - United Nations Environment Programme's Minamata Convention on Mercury convened; a global treaty was agreed upon to eliminate the use of mercury by 2020, which includes the production, import and export of mercury-based weather instrumentation, including mercury manometers.
- SFSC followed suit as mercury poses a health as well as an environmental hazard
- Pressure Standards Laboratory was relocated from the National Weather Service headquarters in Silver Spring, MD to the SFSC
- Desire to automate the calibration processes, create a safer pressure lab environment, and use modern, user friendly equipment

Assets

- Piston Gauge with Automated Mass Handler
- Pressure Controller
- Two Vacuum Pumps
- Nitrogen Supply
- Manifold Pressure System
- Pressure Calibration Software
- Gauge Management Software

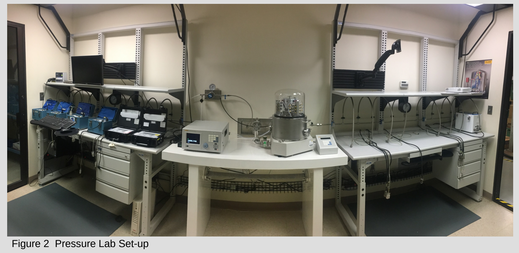

Figure 2 Pressure Lab Set-up

Applications

- Pressure Standards Laboratory (PSL)
  - Calibrate over 500 pressure sensors used in the NWS observing programs
  - Supports the ASOS and Upper Air Observation Programs
- Calibrate transfer standards used in other laboratory areas of the SFSC and in support of collaborative activities with external partners
- Calibrate pressure sensors used in the Wind Tunnel
- Use as a comparison for pressure sensor tests

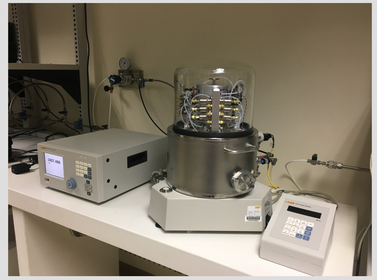

Figure 3 Fluke PPC4 Pressure Controller, PG 7601 Piston Gauge with Automated Mass Handler, Piston Gauge Terminal

Fluke PG7601 Piston Gauge		Fluke PPC4 Pressure Controller	
Pressure Range ~13 kPa to ~135 kPa	Uncertainty ±0.0012% of reading + 0.2 Pa in a range of 8 to 135 kPa absolute	Pressure Range 6 kPa to 110 kPa	Uncertainty ±0.01% of reading or 0.0030% of Q-RPT span, whichever is greater
Mass Set Resolution of 0.1 kg and a full mass load of 13 kg and a minimum of 123 discreet nominal increments of pressure		Precision ±0.008% of reading or 0.0024% of Q-RPT span, whichever is greater	Resolution 1 ppm
Sensitivity 0.02 Pa + 0.5 ppm	Reproducability ±2 ppm		

Modernization

- Hardware
  - New piston gauge with automated mass handler to automate the calibration process
  - New pressure controller to replace a 1960's model; can communicate remotely or manually through screen
  - Implemented manifold and new tubing system
  - New vacuum pumps
  - Changed from compressed air to ultra-pure nitrogen and implemented automated switch-over valves between tanks
  - Implemented a sealed, temperature and humidity controlled environment (23±1 °C, 40±5 %) with the adjoining hygrothermometer lab that is separate from the rest of the main facility building
- Software
  - Fluke Compass for Pressure; used to automate the calibration process and generate calibration certificates
  - PQ Systems GagePack; used to track all pressure lab and PSL assets and email reminders about upcoming calibration due dates

Hygrothermometer Lab

Assets

- Two temperature baths
- Three humidity chambers used for various applications (i.e., better accuracy at low or high humidity, faster response time)
- Reference sensors: Kahn Optisure RS80 hygrometer, an RH Systems 373LHX chilled mirror Hygrometer, and Rosemount 162CE Platinum Resistance Thermometers (used in conjunction with a Fluke Hart 1594A Super Thermometer Measuring Unit)

Applications

- Calibration of various sensors that are utilized with the environmental chambers and test beds
- Calibration of sensors that are used to assist the programs that the SFSC supports (i.e., ASOS, Upper Air, COOP)

Figure 4 Kahn Optisure RS80 Hygrometer

Figure 5 Fluke Hart 1594A Super Thermometer Measuring Unit

Modernization

- New reference Kahn hygrometer; replaced the older Kahn hygrometer of the same make (originally built in 1991)
- New super thermometer measuring unit; replaced the older measuring unit (built in 1995)
- New temperature bath used to achieve low temperature set-points; older bath was repaired and is now used for higher set-points

Figure 6 Fluke Hart 7081 Temperature Bath

Fluke Hart 7081	Kahn Optisure RS80
Temperature Range -80 °C to +110 °C (dependent on heat transfer fluid used)	Measurement Range -80 °C dp to +20 °C dp (-112 °F dp to +68 °F dp)
Set-point Resolution 0.01 °C (0.00007 °C in high-resolution mode)	Maximum Pressure 10 barg (145 psig)
Reservoir Fluid Capacity 42 liters	Temperature Measurement Four-wire Pt100, 1/10 DIN class B

Environmental Chambers

Assets

- Two temperature/humidity walk-in chambers
- An altitude chamber with GPS simulator
- Benchtop temperature/humidity chamber
- Salt fog chamber

Figure 7 Thermotron Altitude Chamber

Thermotron Altitude Chamber	Skydel GPS Simulator
Temperature Range -75 °C to +177 °C	Simulates up to 64 satellites
Pressure Range Ambient down to 5 hPa (approximate elevation of 116,000 ft)	Trajectories are user-defined and can be imported from NMEA or CSV files
Pressure Range Change Rates 1000 to 117 hPa (approx. 176 hPa per minute); 117 to 45 hPa (approx. 7 hPa per minute); 45 to 5 hPa (approx. 3 hPa per minute)	Real-time tracking of simulated trajectory with timestamp and position expressed in longitude, latitude, altitude

Applications

- Test the environmental durability of various sensors that are used to support the ASOS, Upper Air, and COOP programs
- Test radiosonde performance without wasting assets by simulating upper air flight conditions, (e.g., temperature, pressure, wind, ascent rate)

Modernization

- New, more efficient steam generators in the two walk-in temperature/humidity chambers
- New compressors in one of the walk-in temperature/humidity chambers
- New computers and user interface screens in the walk-in and benchtop chambers
- GPS simulator that simulates latitude, longitude, and altitude. This in turn allows for calculation of winds, ascent rate, etc.

Figure 8 Tenney WITR Environmental Chamber Quattro Controller

Figure 9 Skydel GPS Simulator

Wind Tunnels

Assets

- Aerolab 94 feet long High Speed Wind Tunnel with 4ftx4ft and 6ftx6ft test sections
- Custom built Low Speed Wind Tunnel
- Pitot Tubes
- Temperature/RH sensors
- Differential pressure sensors

Applications

- Used for testing and deployment of NWS Ice-Free Wind Sensor
- Used for collaborations to test new and emerging technology

Low Speed Wind Tunnel
Wind Speed Range 0.03 m/sec to 4.1 m/sec (0.06 to 8.1 knots)
Wind Tunnel Dimensions 4.6 m long 0.91 m x 0.91 m test section
Interior Chamber Volume 0.76 m³ (approx. 0.91 m x 0.94 m x 0.91 m)

Modernization

- Upgrade of the Low Speed Wind Tunnel
  - New ¾ horsepower Variable Frequency Drive (VFD) motor
  - Added a pitot tube
  - Added temperature/RH sensors
  - New LabVIEW program to control tunnel and collect data

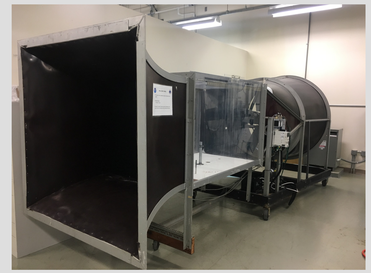

Figure 10 Low Speed Wind Tunnel

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For further information

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