**I. General information:**

1. Mission name: **SENEX 2013**

2. Instrument name: Compact-Time-of-Flight Aerosol Mass Spectrometer (C-ToF AMS) and Particle-Into-Liquid Sampler (PiLS) Collector

3. What is measured: The C-ToF AMS measures the non-refractory (volatile) chemical composition of aerosol particles, including sulfate, nitrate, ammonium, organics, PAHs, and chloride. The PiLS collector impacts particles into an aqueous solution for post-flight chemical analysis of inorganic ions sodium, potassium, ammonium, nitrate, sulfate, and chloride. Chemical composition information is important to understand where the particles came from, how long they might last in the atmosphere, and how they affect the atmospheric radiation budget.

4. Short description of measurement technique: In the C-ToF AMS, ambient air is sampled through an aerodynamic lens into a vacuum chamber. The resulting particle beam is focused. Particles are detected in the instrument by scattered light from a laser. The particles then impact onto a heated surface, where volatile constituents are vaporized, ionized, and drawn into a time-of-flight mass spectrometer. Ions and ion fragments are characteristic of chemical compounds, whose abundance in the original particle is calculated from the mass spectral data. In the PiLS collector, ambient air is first sampled through gas denuders that remove acidic or basic gases. Then, water steam is injected into the sample flow to form droplets from the particles in the ambient air, and these droplets impact onto a flowing aqueous surface. The aqueous liquid containing the soluble and insoluble constituents of the particles is collected into vials for post-flight analysis, mainly by inorganic ion and organic acid anion chromatography. One operator is required for both instruments which are located in the same rack.

5. Contact information for all personnel going to the field with this instrument:

(*for multiple investigators,* *please list the PI or primary contact person first*)

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Email** | **Office phone** | **Cell phone** |
| 1. Ann Middlebrook | [Ann.M.Middlebrook@noaa.gov](mailto:Ann.M.Middlebrook@noaa.gov) | 303-497-7324 | 720-226-2606 |
| 2. |  |  |  |
| 3. |  |  |  |
| 4. |  |  |  |
| 5. |  |  |  |
| 6. |  |  |  |

**II. Specific information:**

**1. Total installed weight: 800.0 lbs (includes SP2 at Station 3)**

(rack, gas cylinders, hoses, cabling, pumps, inlets, permeation tubes, etc.)

**Station 3 Rack, Outboard**

|  |  |  |
| --- | --- | --- |
| **Rack weight and balance info** | **Allowed** | **Actual** |
| Weight, lbs.: | 385 | 317 |
| Overturning moment, in-lbs.: | 11396 | 7282 |

**Station 3 Rack, Inboard**

|  |  |  |
| --- | --- | --- |
| **Rack weight and balance info** | **Allowed** | **Actual** |
| Weight, lbs.: | 272 | 234 |
| Overturning moment, in-lbs.: | 8405 | 5579 |

**Station 3 Seat Position, Outboard**

|  |  |  |
| --- | --- | --- |
| **Rack weight and balance info** | **Allowed** | **Actual** |
| Weight, lbs.: | 262 | 250 |
| Overturning moment, in-lbs.: | 6250 | 5815 |

**NOTE**: Please also provide weight-and-balance information for all installed equipment. Templates for standard electronics racks are available for download [here](http://esrl.noaa.gov/csd/groups/csd7/measurements/2013senex/P3/integration/). PIs with non-standard installations will need to provide relevant information in a similar format.

**2. Individual subassembly info** (weights should sum to total listed above)

|  |  |  |
| --- | --- | --- |
| **Component name** | **Location name and flight station** | **Weight, lbs** |
| 1. AMS/PiLS/SP2 | STA 3 Rack, Outboard, 542 | 317 |
| 2. AMS/PiLS/SP2 | STA 3 Rack, Inboard, 542 | 234 |
| 3. AMS | STA 3 Seat Position, Outboard, 582 | 250 |
| 4. |  |  |
| 5. |  |  |
| 6. |  |  |

**3. Component power consumption in Amps (not including SP2)**

Please provide an electrical power diagram in Appendix A

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Component name** | **Location name** | **400 Hz**  **3Ø** | **400 Hz**  **1Ø** | **60 Hz** | **28VDC** | **28VDC**  **WOW** |
| 1. C-ToF AMS UPS (including UPS, Tofwerk supply, computer, and electronics) | STA3 Outboard |  |  | 4.1 |  |  |
| 2. C-ToF AMS Inlet Pump | STA3 Outboard |  |  | 0.3 |  |  |
| 3. C-ToF AMS Fans | STA3 Outboard |  |  |  | 0.2 |  |
| 4. C-ToF AMS Pressure Readout | STA3 Outboard |  |  | 0.2 |  |  |
| 5. C-ToF AMS Pump Power Supply | STA3 Outboard |  | 3.7 |  |  |  |
| 6. C-ToF AMS Monitor | STA3 Inboard |  |  | 0.2 |  |  |
| 7. C-ToF AMS Solenoid Valves | STA3 Seat Position |  |  | 0.1 |  |  |
| 8. C-ToF AMS Laser | STA3 Seat Position |  |  | 0.1 |  |  |
| 9. C-ToF AMS External Trigger Box | STA3 Seat Position |  |  | 0.1 |  |  |
| 10. PiLS Unit | STA3 Inboard |  |  | 2.6 |  |  |
| 11. PiLS Pump Power | STA3 Outboard |  |  | 2.3 |  |  |
| 12. PiLS Flow Controller | STA3 Outboard |  |  |  | 0.75 |  |
| 12. PiLS Fan | STA3 Inboard |  |  |  | 0.2 |  |
|  | **Totals:** | 0 | 3.7 | 10.0 | 1.15 | 0 |
|  |  | **400 Hz**  **3Ø** | **400 Hz**  **1Ø** | **60 Hz** | **28VDC** | **28VDC**  **WOW** |

**4. Inlet and exhaust information:**

Please provide an inlet/exhaust line diagram in Appendix B

|  |  |  |
| --- | --- | --- |
| **Inlet/exhaust name** | **Location name and flight station** | **Hole size through hull, inches** |
| 1.Instrument Sampling Inlet | LTI Sample Port, B3 Cab aft, 426 | ½” SS Swage bulkhead fitting. Material to STA3 inlets: SS tubing. Shared with WLOPC, CCN, and STA2. |
| 2. C-ToF AMS Exhaust | STA3 Exhaust Line | ½” PFA Teflon. Exhaust does not contain oil or hazardous materials. Exhaust pressure and temperature close to ambient. |
| 3. PiLS Exhaust | STA3 Exhaust Line | ½” PFA Teflon. Exhaust does not contain oil or hazardous materials. Exhaust pressure and temperature close to ambient. |

**5. Source of flow** (name and location of pump or venturi)

|  |  |
| --- | --- |
| **Pump name** | **Location name and flight station** |
| 1. LTI Instrument Inlet | FD Window |

**6. Installed hazardous materials or equipment:**

(only for items *installed* *in the aircraft for use during flight*)

**A. Lasers**

Type: Solid State

Class: IIIb

Wavelength: 405 nm

Output power: 50 mW

Eye-safe? No

Beam fully contained within instrument during normal operation? Yes

*For non-eye-safe lasers, please attach a description of safety measures taken (safety interlocks, beam fully enclosed within instrument, etc.) and a procedure for safe instrument operation during testing and laser alignment. Please contact the* [*AIC*](mailto:carsten.warneke@noaa.gov) *for an example of laser safety documentation from TexAQS 2006.*

**B. RF transmitters**: (note that mass spectrometer RF generators are not designed to transmit, and do not need to be included here) **- NONE**

Description:

Transmitted RF power:

Frequency range:

**C. Radioactive materials: - NONE**

Isotope:

Half-life:

Type of emitter:

Generally licensed?

# installed and location:

# of spares and location:

**D. Compressed gases:** (1 ft3 = 28.32 liters; cabin volume = 4260 ft3 = 1.21 x 105 liters)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Cylinder number:** | **1** | **2** | **3** | **4** | **5** |
| Gas description | CO2 |  |  |  |  |
| Mixing ratio | 100% |  |  |  |  |
| Cylinder size (ft3) | < 0.001 |  |  |  |  |
| Max pressure (psig) | 1800 |  |  |  |  |
| # installed on aircraft | 1 |  |  |  |  |
| Location on aircraft | STA3 |  |  |  |  |
| Service frequency | Preflight |  |  |  |  |
| *toxic/flammable gases:* | No |  |  |  |  |
| In containment vessel? | n/a |  |  |  |  |
| Gas alarm provided? | n/a |  |  |  |  |
| MR if vented to cabin, ppmv | n/a |  |  |  |  |
| OSHA 8-hr PEL, ppmv | n/a |  |  |  |  |
| 30-min IDLH, ppmv | n/a |  |  |  |  |

**E. Chemicals (solids and liquids):**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Chemical number:** | **LiF in H2O** | **Silica Gel** | **H2O** | **4** | **5** | **6** |
| Concentration | < 1000 ppb | 100% | 100% |  |  |  |
| Amount | 0.5 L | 1 L | 1 L |  |  |  |
| Container description | Nalgene Bottle | Poly Tube | Nalgene Bottle |  |  |  |
| Purpose | Calibration | Dry exhaust | Solvent |  |  |  |
| Solution pH | 7 | n/a | 7 |  |  |  |
| Spill kit provided? | Yes | n/a | Yes |  |  |  |

**F. Cryogens: - NONE**

Location:

Description:

Container description:

Quantity on board per flight:

Serviced on the aircraft?

**G. UPS and battery installation:**

Location: STA3 Outboard

Description: (Manufacturer, model no., power) Tripp-Lite, SMART1000RM1U, 60 Hz

Battery type: Leak-proof, maintenance-free sealed lead-acid battery with suspended electrolyte

Has an adjustable input voltage tolerance? (highly recommended)! Yes, 75-154 V

**H. Motors – total of 8 pumps and 8 fans**

#1, Description: AMS Diaphram Pump (for inlet)

Manufacturer name/model no: Pfeiffer/MVP 020-3AC

Motor current draw: 60Hz, 1.7 A startup, <1.7 A running

Thermal interlock enabled? Yes

#2, Description: AMS Diaphram Pump (on instrument)

Manufacturer name/model no: Vacuubrand/MDI Vario SP

Motor current draw: 24 VDC (originally from 1Ø, 400Hz), 7 A startup, <1.5 A running

Thermal interlock enabled? Yes

#3-5, Description: AMS Turbomolecular Pumps (on instrument)

Manufacturer name/model no: Varian/Turbo-V70LP

Motor current draw: 24 VDC (originally from 1Ø, 400Hz), <5 A startup, <1.5 A running (all three)

Thermal interlock enabled? Yes

#6-7, Description: AMS Turbomolecular Pumps (on instrument)

Manufacturer name/model no: Varian/TV 301 Navigator

Motor current draw: 24 VDC (originally from 1Ø, 400Hz), <7 A startup, <3.2 A running (both)

Thermal interlock enabled? Yes

#8, Description: PiLS Scroll Pump

Manufacturer name/model no: Agilent/IDP3B01

Motor current draw: 60Hz, 3.3A startup, 2.3A running

Thermal interlock enabled? Yes

#9-12: Brushless DC Fans (on STA3 rack)

Motor current draw: 28 VDC, <0.6 A startup, <0.4 A running (all 4)

Thermal interlock enabled? Yes

#13-16: Brushless DC Fans (on AMS instrument)

Motor current draw: 24 VDC (originally from 1Ø, 400Hz), <0.4 A startup, <0.4 A running (all 4)

Thermal interlock enabled? Yes

**I. Operator seat requests -**

Test flights: 2 (1 AMS, 1 PiLS)

Transit flights: 1 (share)

Science flights: 1 (share)

**7. Data and plumbing drops**

Network (Cat. 5/6 ethernet) drops requested: NONE

Serial drops requested: 1 for C-ToF AMS

IRIG-B drops (BNC coax connector) requested: NONE

Vacuum/exhaust/ emergency dump lines:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Flow rate, slpm** | **Line pressure, Torr** | **Pump type** | **Trace gas concentration(s)** |
| 1. AMS Exhaust | < 1 | Ambient | Diaphragm | None |
| 2. CO2 Exhaust | Not continuous | Ambient | None | 100% CO2 released upon closing the inlet valve,  < 100 cm3 at 150 PSI |
| 3.PiLS Exhaust | < 30 | Ambient | Scroll | Although the exhaust is dried, it may contain some residual water vapor |

Ground gas service lines (number, location, type of service):

1, ¼” ID black conductive tubing from STA3 rack to dropsonde chute,

delivery of calibration particles in zero air

Other gas lines (number, location, type of service): NONE

Will you be sending data to the AOC data station? NO. If so, please provide the following information:

|  |  |  |
| --- | --- | --- |
| **Parameter name** | **Voltage range** | **Unit conversion** |
| 1. |  |  |
| 2. |  |  |
| 3. |  |  |

**8. Aircraft access**

**a. flight days:**

Pre-flight time requested at aircraft (hours): 3-AMS, 3-PiLS

Routine pre-flight ground support required?

(stands, ladders, forklifts, covers, external equipment, etc.)

Calibration equipment on cart under aircraft

Routine post-flight time requested at aircraft (hours): 1-AMS, 1-PiLS

Routine post-flight ground support required?

(stands, ladders, forklifts, covers, external equipment, etc.)

Patience from crew.

**b. non-flight days:**

Routine external access to inlets or zenith mounts required?

(please describe location, how often, for how long, type of ground support equipment needed, weather constraints, etc.)

Calibration equipment on cart under aircraft delivering calibration particles in zero air with the power supplied through the dropsonde chute, every non-flight, non-hard-down day, all day.

*Please note there is zero access and zero power to the aircraft (including pods) on hard-down days. These occur at least once every seven calendar days while in the field.*

**9. Aircraft maneuvers**

Briefly describe in-flight calibration frequency, duration, altitudes desired:

The C-ToF AMS needs to sample filtered inlet air for gas phase background and electronic baseline measurements as well as single ion calibrations, near start of each flight and after landing, about 15 minutes, any altitude for in-flight cals as long as science data isn’t needed for 15 minutes, ground for post-flight cals.

Briefly describe instrument sensitivity to flight conditions:

(issues during roll/pitch, ascent/descent, sampling in cloud, icing etc.)

The C-ToF AMS can detect contamination during sampling in ice clouds. Not a problem since these data can be removed from the data set during post-flight processing.

**10. Miscellaneous**

*1. Hazmat for preflight/postflight calibrations*: Please describe fully any additional hazardous materials - compressed gases, solvents, radioactive ion sources – that you anticipate *temporarily* bringing onto the aircraft for periodic instrument calibration purposes (e.g., *n*-butanol in a CN counter, 210Po in a DMA, a UPS for power, compressed gas cylinders for calibrations, etc.)

*n*-butanol in a CN counter

210Po in a DMA

Size 50 ft3 zero air

*2. Fabrication and sheet metal support:* Please describe fully any anticipated requests for fabrication or sheet-metal support during installation in Tampa. This list should be kept to an absolute minimum; please recognize that this superb AOC resource is quite limited. To ease the strain on the AOC shop, we will work with each PI to ensure they arrive in Tampa with as much in hand as possible.

None anticipated.

*3. Ferry flight/check flight procedures.* On occasion, AOC will perform an aircraft check flight, during which the instruments may be flown without power. Aircraft maintenance needs may also dictate a ferry flight without science crew or SED techs on board. Instruments should be designed with these eventualities in mind. However, if your instrument requires standby power during this kind of flight, this may be provided at the discretion of AOC personnel.

If so, the flight crew will need to be briefed well ahead of time to ensure proper instrument operation. Please provide with this document a bare-minimum checklist of instrument startup and shutdown procedures requested for these flights.

No special procedure.

**III. Ground laboratory space**

**1. Tampa space requests**:

Power requirements: 15A, 800 W, 110 VAC, 60 Hz + 3 computers

Special requests:

Lab space for a small vacuum chamber, pump, and UPS for detectors

Power in the hanger to pump C-ToF AMS before integration

Flammable liquids storage

**2. Field space requests**:

Workspace, ft2: 200 for AMS, 150 for PiLS

Number of tables/chairs: 3 tables/4 chairs for both AMS and PiLS

Power requirements: 15 A, 800 W, 110 VAC, 60 Hz + 3 computers (AMS)

<10 A, 110 VAC, 60 Hz (PiLS)

Storage space, ft2: 100 for AMS, 100 for PiLS

Other requests:

At least 100 sqft of clean lab space for PiLS, including three tables,

2 chairs, and power.

Flammable liquid storage area – will bring own portable container.