**I. General information:**

1. Mission name: **SENEX 2013**

2. Instrument name: ARNOLD (Airborne Nitrogen Oxide Laser-based Detector)

3. What is measured: NO, NO2, NO3, N2O5, O3

4. Short description of measurement technique:

Cavity ring-down spectroscopy (CRDS) using diode lasers at 662 nm (to detect NO3) and 405 nm (to detect NO2). Other species are converted to either NO3 or NO2 by inlet conversions.

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.Peter M. Edwards | [peter.m.edwards@noaa.gov](mailto:peter.m.edwards@noaa.gov) | 303 497 4379 | 720 354 8130 |
| 2.Willaim P. Dubé | [william.p.dube@noaa.gov](mailto:william.p.dube@noaa.gov) | 303 497 3933 | 303 859 1592 |
| 3.Steven S. Brown | [steven.s.brown@noaa.gov](mailto:steven.s.brown@noaa.gov) | 303 497 6306 | 303 261 2265 |
| 4. |  |  |  |
| 5. |  |  |  |
| 6. |  |  |  |

**II. Specific information:**

**1. Total installed weight: 400.0 lbs**

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

|  |  |  |
| --- | --- | --- |
| **Rack weight and balance info** | **Allowed** | **Actual** |
| Weight, lbs.: | 262.5 + 262.5 | 199 + 192 |
| Overturning moment, in-lbs.: | 7875 + 7875 | 2911 + 2884 |

**Pod weight and CG:**

**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.Zero Air Cylinder | Floor mount, Dual Pax | 35 |
| 2.ARNOLD Rack | Floor mount, Dual Pax | 346 |
| 3.Inlet | Dual Pax Window | 6 |
| 4.Inlet Valve box | Dual Pax Window | 5 |
| 5.Window Plate | Dual Pax Window | 8 |
| 6. |  |  |

**3. Component power consumption in Amps**

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.ARNOLD Rack | Dual Pax |  | 6 |  |  |  |
| 2. |  |  | 9 (start) |  |  |  |
| 3. |  |  |  |  |  |  |
| 4. |  |  |  |  |  |  |
| 5. |  |  |  |  |  |  |
| 6. |  |  |  |  |  |  |
| 7. |  |  |  |  |  |  |
| 8. |  |  |  |  |  |  |
| 9. |  |  |  |  |  |  |
| 10. |  |  |  |  |  |  |
| 11. |  |  |  |  |  |  |
| 12. |  |  |  |  |  |  |
|  | **Totals:** |  | 6 |  |  |  |
|  |  | **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. ARNOLD Winglet | Dual Pax Window | 4” |
| 2. ARNOLD Static port | Dual Pax Window | ¼” |
| 3. |  |  |
| 4. |  |  |
| 5. |  |  |
| 6. |  |  |

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

|  |  |
| --- | --- |
| **Pump name** | **Location name and flight station** |
| 1. ARNOLD Vacuum | Dual Pax |
| 2. |  |
| 3. |  |
| 4. |  |
| 5. |  |
| 6. |  |

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

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

**A. Lasers**

Type: CW Diode

Class: 3B

Wavelength: 405 nm, 662 nm

Output power: 80 mW, 100 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**: None

**C. Radioactive materials:** None

**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 | Zero Air | NO in N2 | O2 | NO in N2 |  |
| Mixing ratio | na | 100 ppm | 100 % | 2 ppth |  |
| Cylinder size (ft3) | 67 | 6 | 6 | 6 |  |
| Max pressure (psig) | 2216 | 2216 | 2216 | 2216 |  |
| # installed on aircraft | 1 | 1 | 1 | 1 |  |
| Location on aircraft | Dual Pax | Dual Pax | Dual  Pax | Dual Pax |  |
| Service frequency | 1 flt | 4 flts | 4 flts | 4 flts |  |
| *toxic/flammable gases:* |  |  |  |  |  |
| In containment vessel? | na |  |  |  |  |
| Gas alarm provided? |  | Yes |  | Yes |  |
| MR if vented to cabin, ppmv |  | 0.14 |  | 2.8 |  |
| OSHA 8-hr PEL, ppmv |  | 25 |  | 25 |  |
| 30-min IDLH, ppmv |  | 100 |  | 100 |  |

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Chemical number:** | **1** | **2** | **3** | **4** | **5** | **6** |
| Concentration | N2O5 solid |  |  |  |  |  |
| Amount | 0.001 kg |  |  |  |  |  |
| Container description | 1=Glass 2=Metal |  |  |  |  |  |
| Purpose | Cal. |  |  |  |  |  |
| Solution pH | na |  |  |  |  |  |
| Spill kit provided? | na |  |  |  |  |  |

**F. Cryogens:**

Location: Dual PAX ARNOLD Rack

Description: Dry Ice (Solid CO2)

Container description: SS and Aluminum container, vented to aircraft exterior

Quantity on board per flight: 0.2 Kg

Serviced on the aircraft? Yes

**G. UPS and battery installation:** None

**H. Motors**

Description: Vacuum Pump

Motor current draw : 1 Ø, 400 Hz, 1.9 A startup, 1.5 A running

Thermal interlock enabled? Yes

**I. Operator seat requests -**

Test flights: 1

Transit flights: 1

Science flights: 1

**7. Data and plumbing drops**

Network (Cat. 5/6 ethernet) drops requested:

A Cat 5 cable from Dual Pax to our seat (Galley) would be helpful

Serial drops requested: 1

IRIG-B drops (BNC coax connector) requested: 0

Vacuum/exhaust/ emergency dump lines:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Flow rate, slpm** | **Line pressure, Torr** | **Pump type** | **Trace gas concentration(s)** |
| 1. |  |  |  |  |
| 2. |  |  |  |  |
| 3. |  |  |  |  |
| 4. |  |  |  |  |

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

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

Will you be sending data to the AOC data station? If so, please provide the following information:

|  |  |  |
| --- | --- | --- |
| **Parameter name** | **Voltage range** | **Unit conversion** |
| 1. N2O5 | 0-5 V | 1 V / ppbv |
| 2. |  |  |
| 3. |  |  |

**8. Aircraft access**

**a. flight days:**

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

Routine pre-flight ground support required? Access to wing to trim inlet tip

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

Routine post-flight ground support required? None

**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.)

None

*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:

Two times per flight

5 to 10 minutes each

Level flight desired, no specific altitude required

Briefly describe instrument sensitivity to flight conditions:

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

None that we are aware of

**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.)

Same as in-flight cal source

*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 at this time.

*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 start-up or shut-down required

**III. Ground laboratory space**

**1. Tampa space requests**:

Power requirements: Single phase, 120 VAC, 60 or 400 Hz

Special requests:

**2. Field space requests**:

Workspace, ft2: 50 ft2

Number of tables/chairs: 1 table, 3 chairs

Power requirements: Single phase, 120 VAC, 1 kW

Storage space, ft2: 50 ft2

Other requests: Vent line (1/4”) to outside

Support / rack / clamp adjacent to work space for cylinders