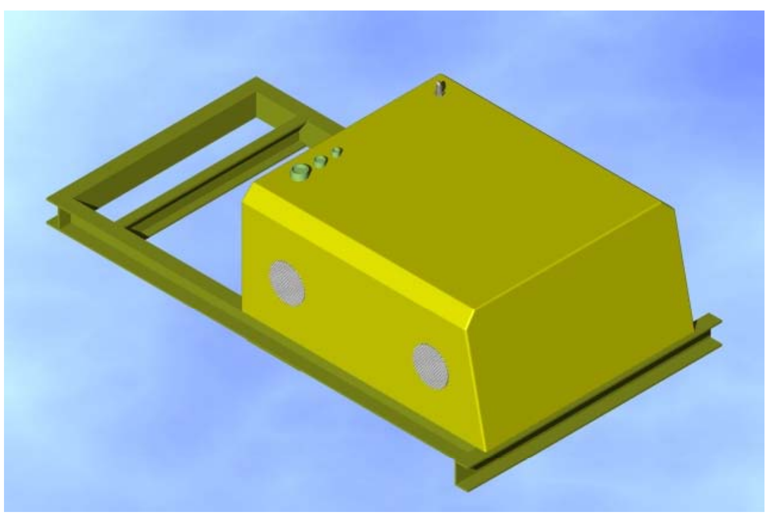
PANTHER PAYLOAD DATA PACKAGE

PAN and Trace Hydrohalocarbon ExpeRiment (PANTHER)

Elkins & Moore, NOAA/CMDL



1. Payload Description

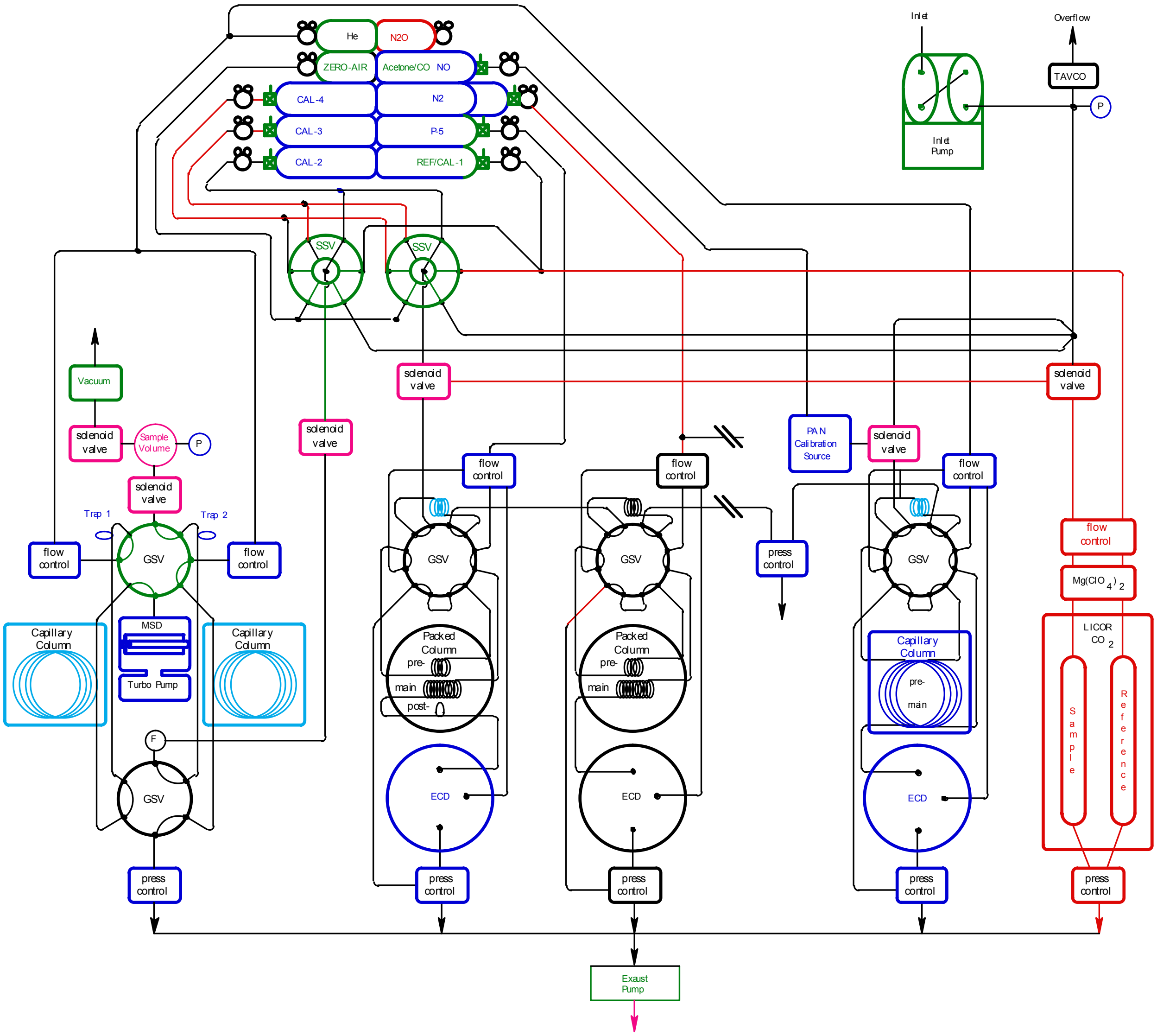
Target Molecules: acetone, PAN, H_2, CH_4, CO, N_2O, SF_6, CFC-11, -12, halon-1211
Method: Mass Spectrometry and Gas Chromatography, including 1 Mass Selective Detector and 4 Electron Capture Detector channel gas chromatograph
Instrument Details: Transition pallet, 200 lbs., 24" w x 28" l x 15" h, 1 kw (2 kw peak)
Sampling frequency: 60-120 seconds
Accuracy: 2% or better, except 10% for PAN
Precision: 1% or better, except PAN at 5% or better.

The extensive pressurized gas system required for GC work is described below.

A high voltage section of the Mass Spectrometer is held at a pressure of 14 psi within an aluminum block approximately 3"x 18 " x 5". It will have an absolute pressure tavco valve setting this pressure and a standard pop off overpressure valve as a backup.

The Mass Spectrometer is contained within a vacuum chamber that has a week gas flow of 10-sccm entering the chamber. A safety pop off valve will also be placed on this chamber.

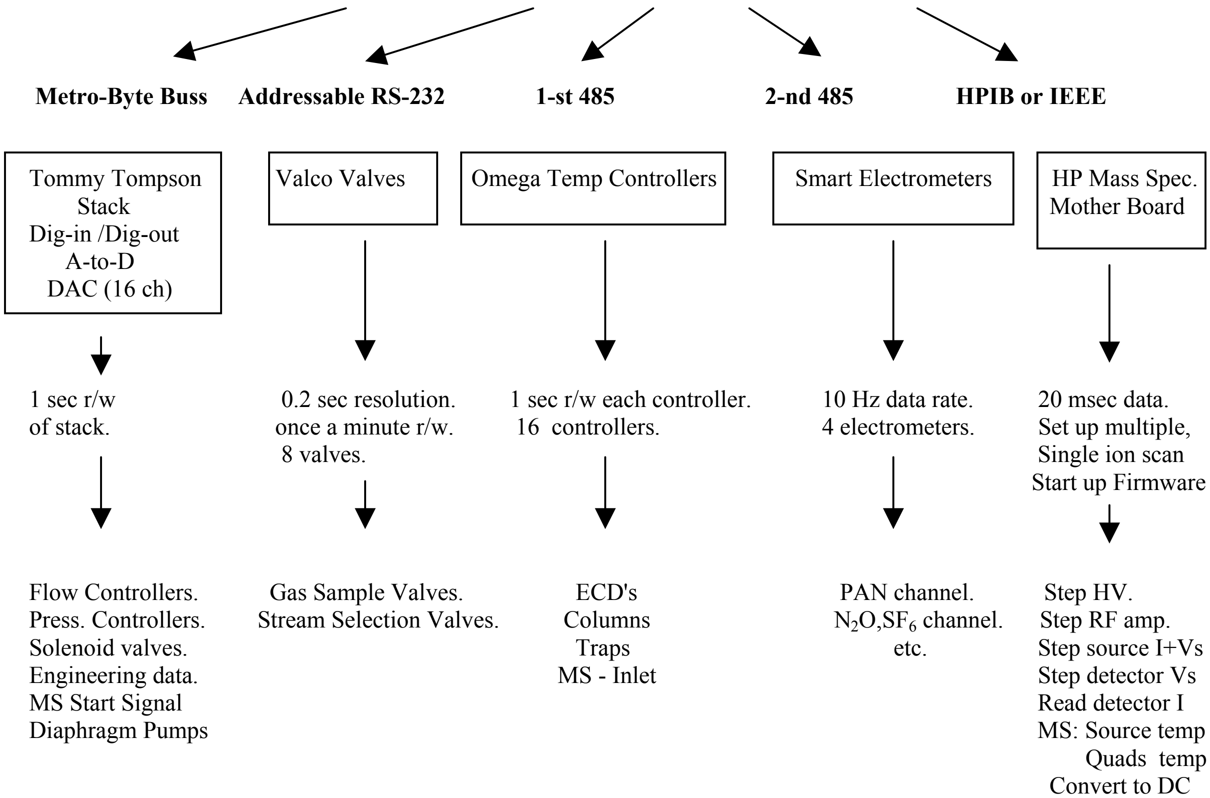
The following diagrams (plumbing and electrical) describe how PANTHER chromatography works:
The CO2 analyzer shown in red will not be in place for the CRYSTRAL FACE mission.



He
N2O
ZERO-AIR
Acetone/CO NO
CAL-4
N2
CAL-3
P-5
CAL-2
REF/CAL-1
Inlet
Overflow
TAVCO
P
Inlet Pump
SSV
SSV
Vacuum
solenoid valve
Sample Volume
P
solenoid valve
solenoid valve
solenoid valve
solenoid valve
Trap 1
Trap 2
flow control
flow control
GSV
MSD
Turbo Pump
Capillary Column
Capillary Column
F
GSV
press control
flow control
GSV
Packed Column
pre-
main
post-
ECD
press control
flow control
GSV
Packed Column
pre-
main
ECD
press control
PAN Calibration Source
solenoid valve
press control
flow control
GSV
Capillary Column
pre-
main
ECD
press control
flow control
Mg(ClO4)2
LICOR CO2
Sample
Reference
press control
Exaust Pump

ELECTRICAL/SOFTWARE OVERVIEW

QNX (Control and Data Acquisition Software) on Ampro Little Board.



2. Structural Analysis

1. Submit free body diagrams (FBDs) for all g-load conditions listed in the Structural Design Requirements Section of this User's Guide (FBDs are sketches used to dimensionally locate where g-loads are applied on test equipment.). G-loads are to be applied at equipment centers of gravity (CGs). See below.

2. Create a table documenting individual component weights and overall payload assembly weight. Specify all materials used for payload fabrication and their allowable loads. Specify all fasteners used, weld types, and their location on the test equipment assembly (this is best accomplished by using a table, detailed drawing/schematic, and/or digital pictures).

ITEMIZED WEIGHT (< 200 lb)

Item	lb (kg)
Mass Spectrometer.	
Vacuum Chamber with MSD + Turbo pump	35.8 (16.3)
Pump (diaphragm)	8.3 (3.7)
Electronics	4.2 (1.9)
	Total = 48.3 (39.1)
G.C. Module (M.S.)	
SSV (Stream Selection Valve)	2.3 (1.0)
Two GSVs (Gas Sample Valve)	4.6 (2.1)
Two Capillary Columns	1.5 (0.7)
Two Traps	2.3 (1.2)
Pressure and Flow Control Module	0.58 (0.26)
Sample Loop (SL)	0.65 (0.29)
SL Pump (diaphragm)	3.7 (1.6)
	Total = 15.6 (7.1)
Pan Module (ECD)	
GSV	2.3 (1.0)
Capillary Column	0.68 (0.31)
Pressure and Flow Control Module	0.58 (0.26)
ECD (Electron Capture Detector) Oven	1.6 (0.72)
PAN Production Cell plus Power Supply	0.71 (0.32)
	Total = 5.9 (2.7)
Packed Column Module (SF_6, N_2O)	
GSV	2.3 (1.0)
Packed Column Oven	1.6 (0.72)
Pressure and Flow Control Module	0.58 (0.26)
ECD (Electron Capture Detector) Oven	1.5 (0.68)
	Total = 6.0 (2.7)
Packed Column Module (CH_4, CO, H_2)	Total = 6.0 (2.7)
Packed Column Module (halon-1211, CFC-11, CFC-12) (or CFC-11, CFC-113, chloroform, MC, CT)	Total = 6.0 (2.7)
GC SSV	Total = 2.3 (1.0)
Remaining Electronics.	
CPU and Stack	3.3 (1.5)
4 Electrometers	0.15 (0.07)
16 Temp. Controllers	4.1 (1.9)
Set of VICOR Power Converters	1.2 (0.54)
	Total = 8.7 (4.0)
Inlet Pump (diaphragm)	Total = 16.7 (7.6)
Gas Cylinders etc.	
Two Air Calibration (ALT 296 C)	4.8 (2.1)
One PAN Calibration (ALT 296 C)	2.4 (1.1)
One He Carrier (ALT 296 C)	2.4 (1.1)
One N2 Carrier (ALM 350)	5.0 (2.3)
or (ALT 639) at 7.0 (3.2)	
3 Al bottles.	1.1 (0.5)
6 Tescom Al Regulators	3.8 (1.7)
2 Tescom SS Regulators	6.2 (2.8)
4 Traps	0.88 (0.4)
	Total = 26.6 (12.1)
Estimate for structural and wire.	Total ≈ 30 (13.6)

Structural aluminum is hogged out 2024--T3 1/2" plate, 2024-T3 0.025 sheet, 2024-T3 "L" brackets, and 6061-T6 hogged out 1/2" plates. Structural bolts are 1/4-28 (AN4-6A and / or MA20004-12), 10-32 and 8-32 (AN525-). Bolts thread into aircraft plate nuts (MS21069L4, MS21070L3, MS21048L08, MS21052L08, MS21087L08, MS21048L06, MS21069L06, MS21052L06, MS21069L04.) An occasional locking helical insert or locking nut (MS21083N-) is used. Rivets used are primarily MS20470AD and MS20426AD with an occasional Cherry Max blind aircraft rivet (CR3212-4-2, CR3213-4-1) used. Gas bottles are held by two "Voss Ind. Inc." (T3237H-62-536-SL, T3237H-62-402-SL) stainless steal mounts.

3. For all structural welds, submit certification documents as specified in SAE specification AMS-STD-2219. Contact the WB-57 Program Office for further instruction. We have no welds.

4. Submit all design calculations showing compliance with all payload structural design requirements (design and crash load) on:

   a. The attachment of components to the payload frame (prove all components will remain intact and attached to the payload frame under the g-loads specified in the Structural Design Requirements section) We have no external attachments beyond the inlet line. All elements are contained within a sealed 0.025" thick 2024-T3 aluminum shell.

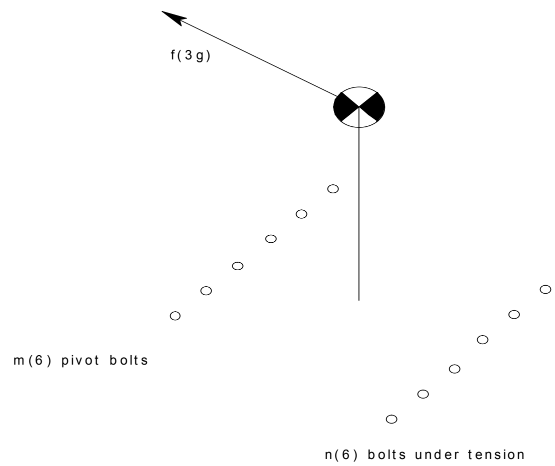
   b. The full assembly (prove the frame will withstand the g-loads specified in the Structural Design Requirements Section, induced from its own mass and those masses of the components attached to it) I will have M. Shine NOAA/AL run a structural analysis on the main plate for a 4.5 g load down. I will wait until this plate is finalized to do this.

   c. The attachment of the payload to the aircraft (prove all fasteners attaching the payload to the airplane will withstand g-loads specified in the Structural Design Requirements section) To be defined by Michael Edmonds.

5. Provide a table that displays the factor of safety/safety margin result from each structural analysis performed. Label the load case analyzed (i.e. 3g forward load), location of the analysis on the payload assembly (i.e. pump bracket attachment), and calculated factor of safety or safety margin. (All five load moments (up, down, aft, forward, and lateral) for the element were calculated, shown in table are the load moments that result in the lowest safety factor for the element. All elements are contained within a sealed 0.025" thick 2024 T3 aluminum shell. Elements not shown have safety factors estimated at greater than 100 because of their small individual weight and or low CG.)

Element.	Max load on Bolt	Safety Factor
Main PANTHER bolt down	Forward 3g on 1/4-28 AN	28
Mass Spec +Turbo bolt down	Down 4.5g on 10-32 AN	24
Gas Bottles bolt down	Down 4.5g on 8-32 AN	140
Center Plate bolts down	Forward 3g on 8-32 AN	>> 4.8

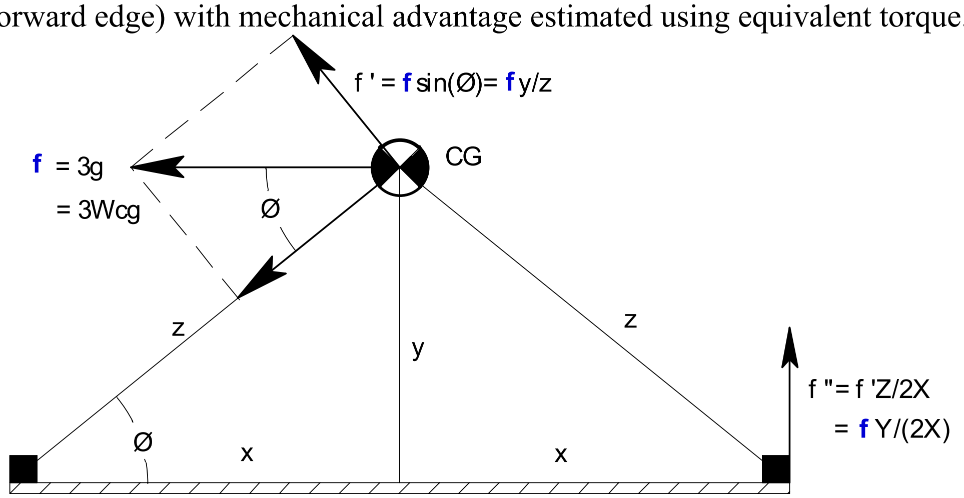
Calculations for tension and sheer on structural bolts follow below logic.



Shear is applied uniformly to all **m+n** bolts. Where the shear force on a single bolt is
$\mathbf{f_S = f/(m+n)}$.

Assume that **m** forward bolts (or edge of material) form a pivot point for a rigid rotor that puts tension on the **n** back bolts.

Tension, uniformly distributed on **n** back bolts, is calculated assuming a rigid rotor around pivot bolts (or forward edge) with mechanical advantage estimated using equivalent torque.



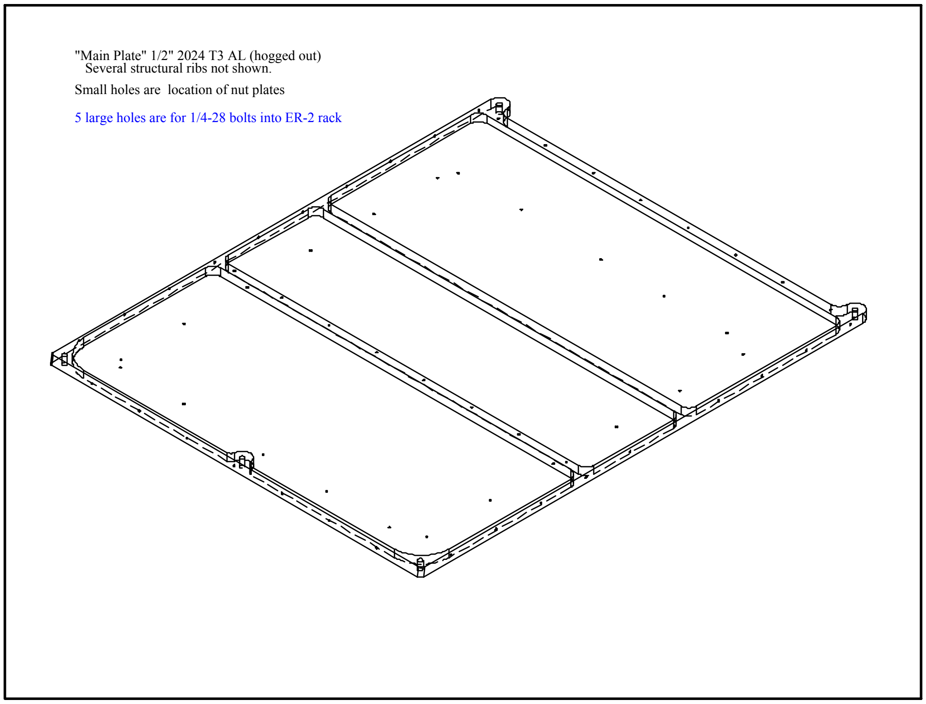
Tension on single bolt $\mathbf{f_T} = f''/n = (z/2x)(f'/n) = (z/2x)(f/n)\sin(\phi) = \mathbf{f \bullet y/(2 \bullet n \bullet x)}$ were **f** is the applied force of $\mathbf{3 \bullet g = 3 \bullet W_{cg}}$ applied at the center of gravity.

Max load on bolt (assuming tension and shear simply add) is:

$$\mathbf{L_B = 3 \bullet W_{cg}\, [1/(n+m) + y/(n \bullet 2 \bullet x)]}.$$

Main support of PANTHER

Main support of PANTHER is supplied by **4 1/4-28 AN** bolts at the corners. A 5th bolt is available out but will not be used in the analysis. All elements of PANTHER are contained within a **2024-T3 aluminum shell** secured to the main plate shown below.



Max load will occur on the two bolts under both tension and sheer with **m=2**, **n =2**, and **Wcg = 200 lb** located **6"** above the geometric center of the plate. Therefore **Y= 6"** and **2X = 27.5** for forward and aft loads, and **2X = 22.5** for side loads.

Forward/Aft at 3 g : **L_B = 3•200(lb)[1/4 + 6"/(2•27.5")] = 215 lb** per bolt**.**

Lateral at 1.5 g : **L_B = 1.5•200(lb)[1/4 + 6"/(2•22.5")] = 115 lb** per bolt**.**

Up at 2 g : **L_B = 2•200(lb)[1/4] = 100 lb** per bolt**.**

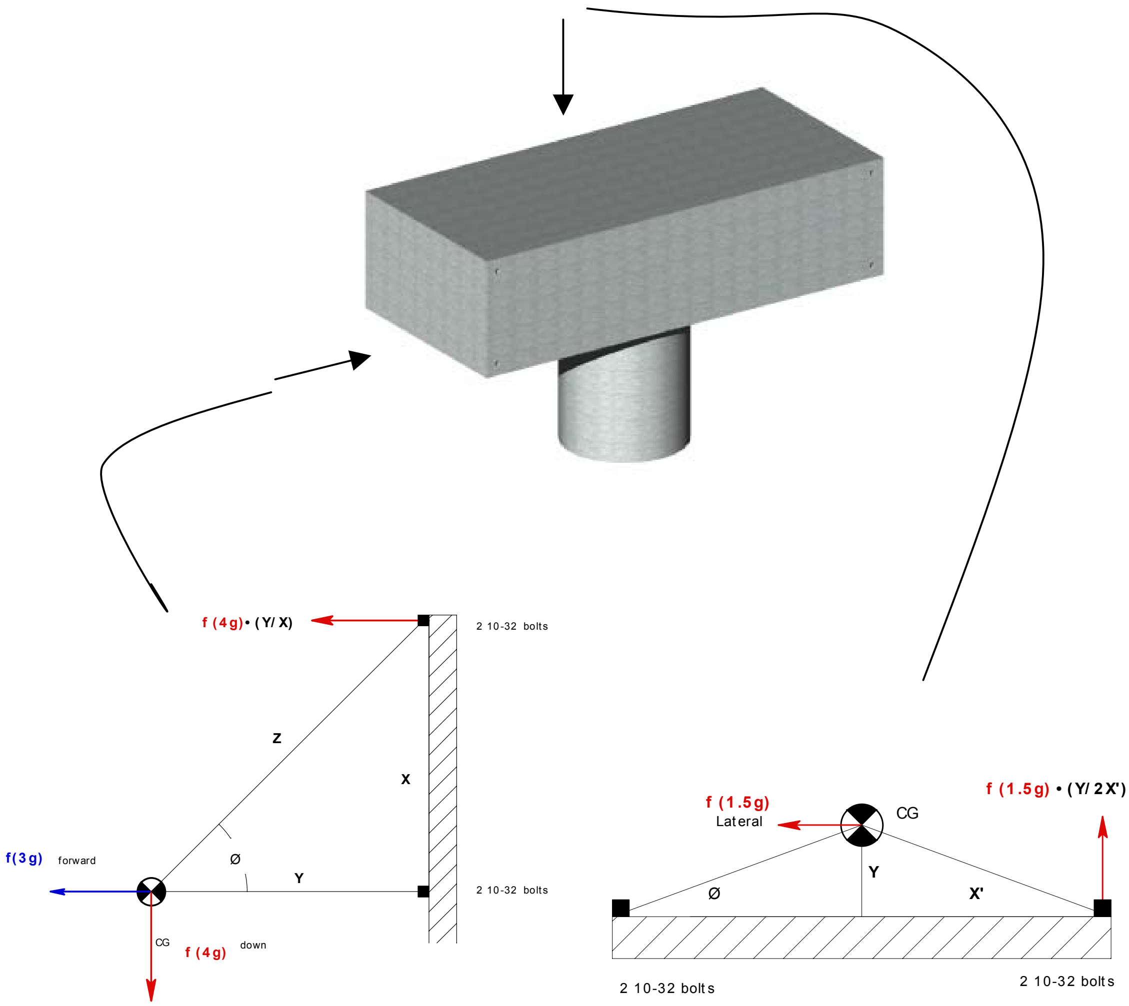
Down at 4.5 g : No load on bolts.

AN rating on a 1/4-28 bolt is **125,000(psi.)•0.049(si)** = **6135 lb** per bolt.

Safety Factors on 1/4-28 bolts ≥ 6135 / 215 = 28

Three Major Internal Structure Issues.

Mass Spec./Turbo Pump: The combined weight of the Mass Spec. and Turbo Pump is under **40 lb**. It is bolted to the 1/2 hogged out Center Plate with **4 10/32 AN** bolts. In addition it is retained by a clamp ring on the bottom of the Turbo pump for added support but this will not be used in the analysis. In the lower diagrams **X** = **Y** = **5”** and **2X'** = **17”.**



Forward at 3 g : Assuming all load comes to bare in tension on lower 2 10-32 bolts (ignoring help from upper 2 bolts). $\mathbf{L_B = 3 \bullet 40(lb)/2 = 60\ lb}$ per bolt.

Aft at 1.5 g : No load on bolts.

Down at 4.5 g : With all 4 bolts sharing the shear force, the two upper bolts also under tension have the largest load per bolt. $\mathbf{L_B = 4.5 \bullet 40(lb)[1/4 + 5"/(2 \bullet 5")] = 135\ lb}$ per bolt.

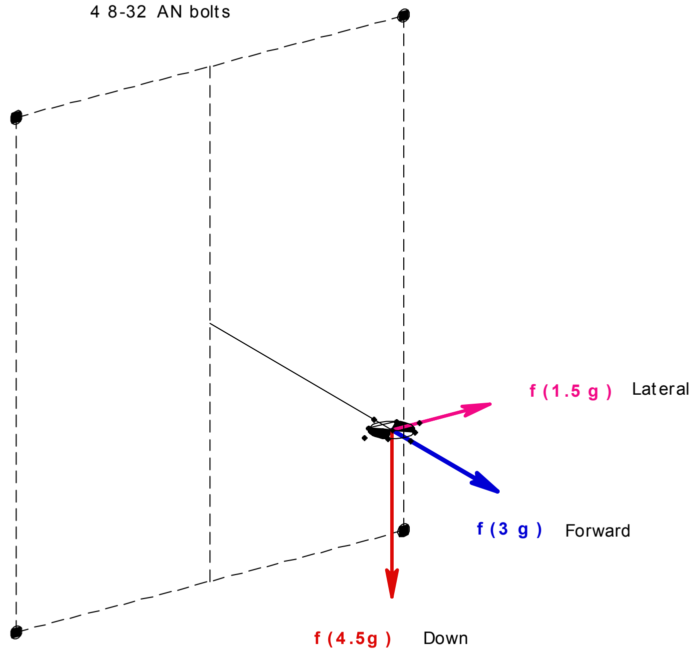
Up at 2 g : With all 4 bolts sharing the shear force, the two lower bolts also under tension have the largest load per bolt. $\mathbf{L_B = 2 \bullet 40(lb)[1/4 + 5"/(2 \bullet 5")] = 60\ lb}$ per bolt.

Lateral at 1.5 g : With all 4 bolts sharing the shear force, the two side bolts also under tension have the largest load per bolt. $\mathbf{L_B = 1.5 \bullet 40(lb)[1/4 + 5"/(2 \bullet 17")] = 24\ lb}$ per bolt.

AN rating on 10/32 bolt is 125,000(psi.)•0.026(si) = **3267 lb** per bolt.

Safety Factors on these 10-32 bolts $\geq$ 3267 / 135 = **24**

Gas Bottles : Each large gas bottle is mount to the center plate or the main plate with two commercial clamp rings. Each clamp ring is mounted with two 8-32 AN bolts for a total of 4 8-32 AN bolts per gas bottle. The Largest gas bottle has a Wcg = 7 lb with a CG 3.5" off the plate.

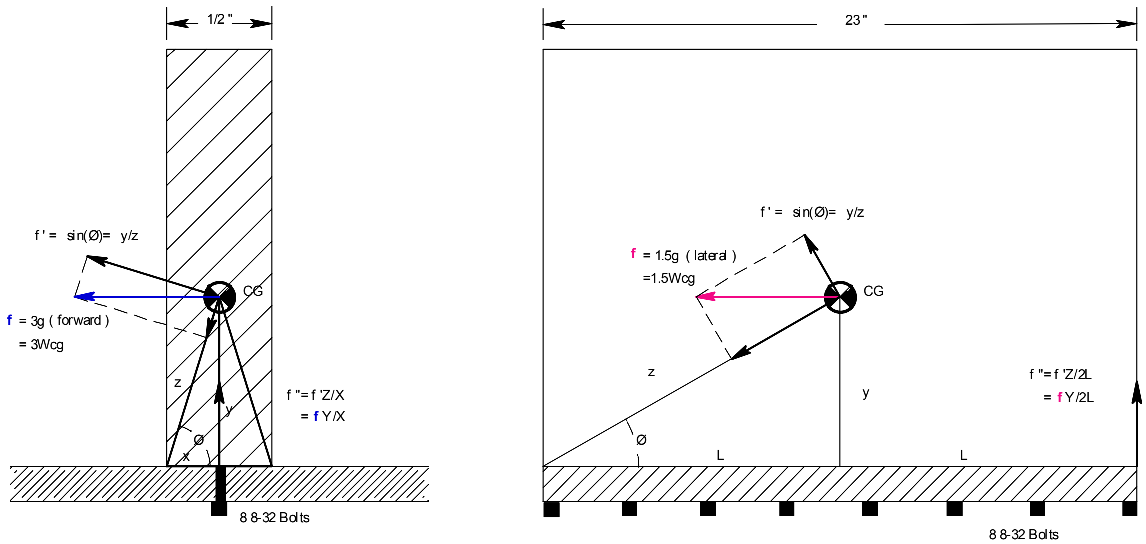


Forward at 3 g : With equal tension on 4 bolts: L_B **= 3•7(lb)[1/4] = 5.25 lb** per bolt.
Aft at 1.5 g : Induces no load on bolts.
Lateral 1.5 g : With all 4 bolts sharing the shear force, the two left bolts also under tension have the largest load per bolt. L_B **= 1.5•7(lb)[1/4 + 3.5"/(2•5")] = 6.3 lb** per bolt.
Down at 4.5 g : With all 4 bolts sharing the shear force, the two upper bolts also under tension have the largest load per bolt. L_B **= 4.5•7(lb)[1/4 + 3.5"/(2•6")] = 17 lb** per bolt.
Up at 2 g : With all 4 bolts sharing the shear force, the two upper bolts also under tension have the largest load per bolt. L_B **= 2•7(lb)[1/4 + 3.5"/(2•6")] = 8 lb** per bolt.

AN rating on 8/32 bolt is 125,000(psi.)•0.020(si) = **2512 lb** per bolt.

Safety Factors on these 8-32 bolts ≥ 2512 / 17 = 140

Center Plate mounted to Main Plate: The Center Plate has mounted to it the 40 lb Mass Spec., 8 gas regulators that add 9 lb, and 3 or 4 gas bottles which add as much as 10 lb. The plate it's self will add 2 lb. Wcg = 67 lb for this plate and the CG is approximately centered at 6" off the main plate. It is bolted on edge to the main plate with eight 8-32 AN bolts. In addition is has its sides supported by 0.025" thick 2024 T3 sheet metal under tension for forward and aft loads. The mass spec is also supported at the bottom by a clamp ring attached to the main plate approximately 5" from the Center Plate effectively forming a cross member. We show below that ignoring these cross supports and using only the eight 8-32's we still have a safety margin of 4. The true safety margin is much higher.



Forward at 3 g : With equal shear and tension on 8 bolts we have the load per bolt:

L_B = 3•67(lb)[1/8 +5"/(8•0.25")] = 527 lb per bolt**.**

Aft at 1.5 g : With equal shear and tension on 8 bolts we have the load per bolt:

L_B = 1.5•67(lb)[1/8 +5"/(8•0.25")] = 263 lb per bolt**.**

Lateral 1.5 g : With all 8 bolts sharing the shear force, if we assume the far right bolt picks up all the tension (ignoring the other 6 bolts) we have the largest load per bolt:

L_B = 1.5•67(lb)[1/8 + 5"/(8•23")] = 16 lb per bolt**.**

Down at 4.5 g : Induces no load on bolts.

Up at 2 g : With all 8 bolts sharing the tension force, **L_B = 2•67(lb)[1/8] = 17 lb** per bolt**.**

AN rating on 8/32 bolt is 125,000(psi.)•0.020(si) = **2512 lb** per bolt.

Safety Factors on these 8-32 bolts ≥ 2512 / 527 = 4.8

3. Electrical Load Analysis

Instrument Name:	PANTHER. Preliminary (Accurate estimate not measured)			
	AMPS			
Voltage	Nominal	Maximum	Peak Inrush	Notes
28 VDC (#1-#2)	9-20	27.5 –24.7	27.5 –24.7	Two 28 volt lines
115 VAC 60 HZ (Single Phase)	1.8	4.5	4.5	
115 VAC 400 HZ (Single Phase)				
115 VAC 400 HZ (Three Phase - A)				
115 VAC 400 HZ (Three Phase - B)				
115 VAC 400 HZ (Three Phase - C)				

We have 10 ovens on the 115 60HZ line Once they come up to temperature the current draws are dropped substantially as the temperature locks kick in.

We have 6 valves using stepper motors that are actuated for 0.2 seconds once ever 60 seconds. They draw high currents for this short duration resulting in the high max rating on the first 28-volt line.
Note that we will be using the high current duel 28 volt (????) connector on the ER-2 patch panel.

4. Pressure/Vacuum Systems

The PANTHER instrument has three sections that fall under this heading.

A). We fly pressurized gas cylinders (2,500 psi and lower) which feed into the instrument through pressure regulators with the low side set below 100 psi. Each regulator has a safety relief valve on the low-pressure outlet, set to 100 psi to prevent the possibility of instrument overpressure due to accidental cross-port leakage in the regulator.

We will FedEx a "pressurized gas diagram" of all the cylinder, valve, and regulator model numbers and the cylinder DOT ratings. Also included will be zerox copies of the current cylinder certifications, which are permanently attached to the cylinders. A table which lists the manufacture and specs for all parts in this system will also be given.

B). We fly a commercial Hewlett-Packard vacuum vessel which houses the Quadrapole mass spectrometer. It is evacuated through a turbo pump ruffed by a diaphragm pump. Though under vacuum in normal operation, pressurized gas is feed into the vacuum chamber. A safety release valve is therefore plumbed into the chamber to prevent inverted pressurization. A drawing of the enclosure and flow diagram will be FedEx-ed shortly.

C) The Mass Spec. has high voltage DC, and RF fed into the vacuum chamber. It is therefore necessary to have this small section of the instrument held to pressures above 300 mb to prevent high voltage breakdown and or excessive loss to corona. A single piece machined aluminum cover will be placed over this section and held 400 mbar above ambient pressure by gas flow through a pop off valve. A secondary 500 mbar safety release valve will also be in place. This chamber will be certified by in house over pressurization tests which can be repeated on site if necessary. Though no drawings exist at the present time. They will be forwarded to you as soon as they are available.

5. Laser Systems

PANTHER dose not fly a LASER.

6. Hazard Analysis Report Guidelines

HAZARD SOURCE CHECKLIST

Enumerate or mark N/A

__X__ Flammable/combustible material, fluid (liquid, vapor, or gas)

PANTHER requires lab use of small quantities of Acetone, Ethanol, and H_2 gas for cleaning purposes. The Acetone and Ethanol will be stored in a flammables cabinet supplied by JSC, and H_2 gas will be stored in the gas racks outside the hanger.

__X__ Toxic/corrosive/hot/cold material, fluid (liquid, vapor, or gas)

The PANTHER instrument will fly five independent ovens with temperature-controlled zones between 15° to 380°C. These are contained within aluminum housings and have resetable thermal relays wired in series with the heating elements to prevent thermal runaway.

__X__ High pressure system (static or dynamic

As stated in section 1.1-A. PANTHER requires the use of pressurized gasses. See this section for details.

__X__ Evacuated container (implosion)

As stated in section 1.1-B. PANTHER requires the use of an evacuated chamber. See this section for details.

_NA__Frangible material

_NA__Stress corrosion susceptible material

_NA__Inadequate structural design (i.e., low safety factor)

_NA__High intensity light source (including laser)

__X__ Ionizing/electromagnetic radiation

The PANTHER instrument requires High Voltage, which is susceptible to corona and or HV breakdown at the WB-57 minimum pressure (maximum altitude). To prevent this we are pressurizing this section of the instrument. (See section 1.1-C).

__X__ Rotating device

The Turbo pump (Edwards), which pulls a vacuum on the Mass Spec, is rotating at 6,000 rpm. It is supported by both a ceramic and magnetic bearing. A secondary crash bearing to protect against failure backs up the magnetic barring. The turbo drive is limited and then shut off by thermal sensors at the main bearings in the event of excessive load. This commercial system has been designed to survive direct venting to the atmosphere.

_NA__Extendible/deployable/articulating experiment element (collision)

__?__ Stowage restraint failure

I am not sure what is needed here; however, the PANTHER instrument is entirely encased within a sheet aluminum shell. This shell has inlets for fans, which have a screen mesh seal to prevent any internal objects from exiting the shell and any external objects from interring the shell. In the unlikely event that a piece of PANTHER comes loose, it should still be contained within this aluminum shell.

__X__ Stored energy device (i.e., mechanical spring under compression)

There is angular momentum and energy stored in the Turbo pump. (See "Rotating device" above for a description of the concerns and how they are addressed.).

__X__ Vacuum vent failure (i.e., loss of pressure/atmosphere)

In the event that our small pressurized chamber (see section 1.1-C) depressurized there is the potential for HV break down. This could potentially harm charge sensitive components within the chamber however the risk to elements out side the (grounded) chamber should be small. The High voltage is very low power. A pressure sensor will monitor this chamber and can be used to shut down the high voltage if depressurization occurs on a relatively slow time scale (2 sec.). We will be receptive to recommendations of specific crowbars etc to be placed on our cabling to and from the patch panel.

_NA__Heat transfer (habitable area over-temperature)

We are not in a habitable area.

_NA__Over-temperature explosive rupture (including electrical battery)

We have no explosive elements. Our ovens have thermal relays as stated above under heading "Toxic/corrosive/hot/cold material, fluid (liquid, vapor, or gas)."

_NA__High/Low touch temperature

We have no exposed hot or cold elements.

__X__ Hardware cooling/heating loss (i.e., loss of thermal control)

We will have thermal relays in series with all of our cooling and heating devices.

_NA__Pyrotechnic/explosive device

__X__ Propulsion system (pressurized gas or liquid/solid propellant)

We will have pressurized gases as described in section 1.1-A. Venting of these cylinders is only possible through the cylinder's Valco valve that has a Valco 1/16 inch output port (ID = 0.040 in). The valve it's self is rated to 6000 psi. and the maximum pressure in any of our cylinders is 2,500 psi.. The force generated by exhaust through this 0.040 inch port is negligible compared to the weight of the gas bottles supported at better than 4-G inside the instrument enclosure.

_NA__High acoustic noise level

_NA__Toxic off-gassing material

_NA__Mercury/mercury compound

_NA__Organic/microbiological (pathogenic) contamination source

_NA__Sharp corner/edge/protrusion/protuberance

Standard machining practice is to break all sharp edges and round corners.

__X__ Flammable/combustible material, fluid ignition source (i.e., short circuit; under-sized wiring/fuse/circuit breaker)

All wiring is Teflon insulted and gauged appropriately to handle peak current draws. When possible wire bundles are encased in braded mechanical shielding and restrained to prevent insulation breakthrough due to rubbing. We have also employed liberal amounts of fusing, both on the incoming power and on the redistributed power. All major current drawing devices are also individually fused such as our heaters. The braiding, isolation and virtually all other components of the instrument are non-flammable.

__X__ High voltage (electrical shock)

We have High voltage however it is of low power and is contained within an aluminum housing.

_NA__High static electrical discharge producer

__X__ Software error or computer fault

A "watchdog program" sends an AC (toggled digital) signal to a circuit board which rectifies the signal. This rectified signal is used to hold the fail light off. In the event of most software failures or a computer failure the AC signal is interrupted and the fail light will go on. The backseat pilot is then instructed to cycle the power to get the computer to reboot. I the event that several reboots do not work the instrument is turned off for the duration of the flight.

_NA__Carcinogenic material

We have no Carcinogenic materials.

______ Other:____

7. Ground Support Requirements

In this section of the Payload Data Package, describe what you will need in terms of ground support from the WB-57 Program Office. Please address the following:

1. Type of ground power needed for testing/operating research equipment.
   We will need 20 amps 60 Hz 110 volts dedicated to the PANTHER instrument. We would like at least one addition independent 60 Hz 110 volt outlet for laboratory computers, printers, etc.

2. The need for any pressurized gas or cryogenics. State how much is needed of each to assess storage space. Procurement of pressurized gases or cryogenics will be the responsibility of the researcher. MSDS sheets must be provided.
   We will need storage space for at least eight standard gas cylinders in the lab near the PANTHER instrument. (Six air cylinders, one N_2 cylinder, and one He cylinder.) We will also occasionally use a standard size H_2 cylinder and

two small cylinders one containing N_2O and the other containing CO_2, however these can be stored outside the lab/hanger space.

3. State whether or not you will be mixing or storing any chemicals that are toxic, corrosive, and/or explosive. If so, what type of material handling procedures will be required? We will be using small flows (10 sccm) of H_2 gas to occasionally clean our detectors and must have the capability of venting this gas to the outdoors. We will have plenty of tubing but must have a nearby window, vent hole, or hood. We would also like to vent our ruffling pump exhaust in a similar manner to avoid oil deposition on other instruments.

4. Working hours/access to building 994 (the WB-57 Payload Laboratory). Will you need access during hours other than normal business hours (7 a.m. – 5 p.m., M-F)? If at all possible we would like 24 hour access to our lab space. Access to the WB-57 by pre-approved permission on minimal case-by-case bases is OK.

5. Requests for special ground handling/support equipment (e.g. forklift, crane, etc.). We anticipate the need for a forklift only during shipping and receiving. We will need a hand jack (similar to that supplied for the LACE instrument.) to lift the 200 lb PANTHER instrument for upload into the WB-57 aft-section.

6. Miscellaneous requests. 100 square feet lab space, 5 network connections (we can potentially bring our own hubs.). Access to a chemical and flammable storage cabinet.

8. Hazardous Materials

A list of hazardous materials along with MSDS, and where appropriate, UN# and DOT# will be sent to the WB-57 program office.

9. Material Safety Data Sheets

A list of hazardous materials along with MSDS, and where appropriate UN# and DOT# will be sent to the WB-57 program office.

10. Mission Procedures

Equipment Shipment

State how equipment will be shipped (e.g. freight - include the shipping company name), when it will be shipped (i.e. month, day, and time), and what storage requirements are needed to safely store your hardware (e.g. space requirements, temperature, etc).

Our shipping department use Consolidated Freight almost exclusively and Consolidated Freight will not load nor unload their trucks. We will have to be on site to both load and unload our equipment at the hanger when the truck arrives. Use of a forklift may be beneficial at this time. The equipment will be unloaded and immediately moved into our lab space so no intermediate storage will be necessary. Approximately 40 cubic feet of storage of empty boxes and other minor items will be necessary. There is a strong chance that it will be possible for us to piggyback on a major shipment of multiple groups out of the Aronomy Laboratory. If so, no temporary storage would be necessary as we would be moving our equipment directly into our lab space. Shipping dates are unknown at this time.

Ground Operations

State the procedures proposed to set-up and operate your equipment on the ground at Ellington Field. All equipment will be inspected at the Test Readiness Review prior to flight.

Normal Ground Operations for PANTHER: A table will be erected over cabinets which store general lab supplies and equipment. The PANTHER instrument and supporting electronics will be deployed on this table. Support computers, printers, and personal items will be deployed on a large table or desks. Gas bottles will be secured safely and gases will be plumed into the PANTHER instrument. After a visual and electrical inspection of the PANTHER instrument, it will be turned on and wormed up. Each channel of chromatography will be verified, and appropriate cleanup of columns and detectors will take place. Finally, flight cylinders will be filled and calibration will be run. Flight cylinders will be refilled to bring PANTHER into flight ready status.

Note: PANTHER will not be flying the test flights in May. We will make PANTHER available for a Test Readiness Review at the start of these test flights, however the ability to work on and run the instrument in the lab will not be available at this time. Electrical caballing, mechanical fit, and safety reviews/inspection should be possible.

Loading

State the procedures proposed to load and integrate your equipment onto the WB-57.

We will show up with a rack that PANTHER mates to. This rack will be mounted to the JSC supplied structure which drops down from two cross beams above the aft-pallet. Load up will consist of hand jacking PANTHER to a height that will allow it to slide onto this rack. It will then be bolted onto the rack. An end piece crossbeam will be attached to complete the rack. Pluming to the old LACE inlet through holes in the bulkhead and electrical connection to the old LACE ER/2 patch panel will also occur through the holes in the bulkhead. We will show up with a ready-made flight cable which mimics our lab cable minus the connectors that mate to the ER/2 stile patch panel. We are assuming that these connectors will be supplied by JSC when we show up and the cable will be completed on site, as was the case for LACE during ACCENT. This guaranties that the cable will mate properly. A series of test will be completed to verify the power is appropriate and the fail light works correctly.

Pre-Flight

State the procedures proposed for pre-flight operations.

We will be loading the instrument prior to each flight. The instrument will be wormed up prior to upload so that minimal worm up is needed to verify proper operation of the instrument after load up. It is assumed that 30 min. will still be needed to bring the instrument to operational temperature after load up. An additional 30 min. will be needed to check out the proper operation of the instrument, which will include the following. Recording all gas cylinder pressures. Visual inspection of the chromatography on each channel. Visual inspection of all engineering data. Cycling of the inlet pump to verify that there are no leaks in the system and that the pump is operational. Rechecking all gas cylinder pressures for appropriate consumption rates. Cycling of the power to verify that the fail lights are operational. Running a clean up program to clean up the flash disk followed by power down and hands off.

Flight Operations

Flight checklists for payload operation will be generated through researcher consultation with the WB-57 sensor operator. Please state the backseat procedures that will most likely be requested to operate your payload during take-off, cruise, and/or landing operations.

Powered on when aircraft power is continuously available without interruptions. Fail light circuitry will be operational after the computer boots, which should take approximately 1 min. This should occur well before taxi.

Power off as low as possible but safely before interrupting the backseater's high demand duties on approach.

On fail (except while computer is booting during first 1 min after any power up) power PANTHER down and wait 30 sec for instrument to shut down. Then power PANTHER on and look for fail light to operate correctly within 1 min. (when the computer boots). If fail condition still exists cycle power as previously prescribed one more time. After weighting the 1 min. for the computer to boot and fail condition still exists power down instrument for remainder of the flight.

Post-Flight

State the procedures proposed for readying equipment for a following flight.

PANTHER is offloaded and moved to lab. Data is offloaded to a ground computer for distribution and processing. PANTHER is re-plumbed from flight cylinders to lab cylinders, supplied lab power and turned on to run and stay clean. Flight cylinders are refilled as needed, and traps are replaced as needed. Occasionally the chromatography is modified and calibrations are rerun. As this is a new instrument this will probably occur more often than we would like. Partial disassembly for visual inspections will also occur early in the deployment until we are satisfied with the performance of this new instrument. Two hours before load up the instrument will be running off lab power and lab gas. Less than 30 min. before load up the instrument is re-plumbed into the flight cylinders and checked out for load up.

Off-Loading

State the procedures proposed for off-loading your payload from the WB-57. State the shipping arrangements that have been made for the removal of equipment from NASA property.

It is assumed that PANTHER will be off-loaded after each flight. This should take less that 30 min. after we gain access to the region in front of the aft-pallet **implying that the pallet in front of the aft-pallet will have to be removed**. The power cable will be removed at the instrument and left with the WB-57. The inlet will be removed at the instrument, plugged top and bottom and will be left with the WB-57. The front crossbeam of the rack will be removed and the instrument will be unbolted from the rack, slid onto a hand jack and rolled into the lab.

All equipment will be removed from NASA property after the mission ether by Consolidated Freight or by piggybacking on an Aeronomy Lab shipment similar to what was stated in section "Equipment Shipment."