IMPACT/SEP Contamination Control

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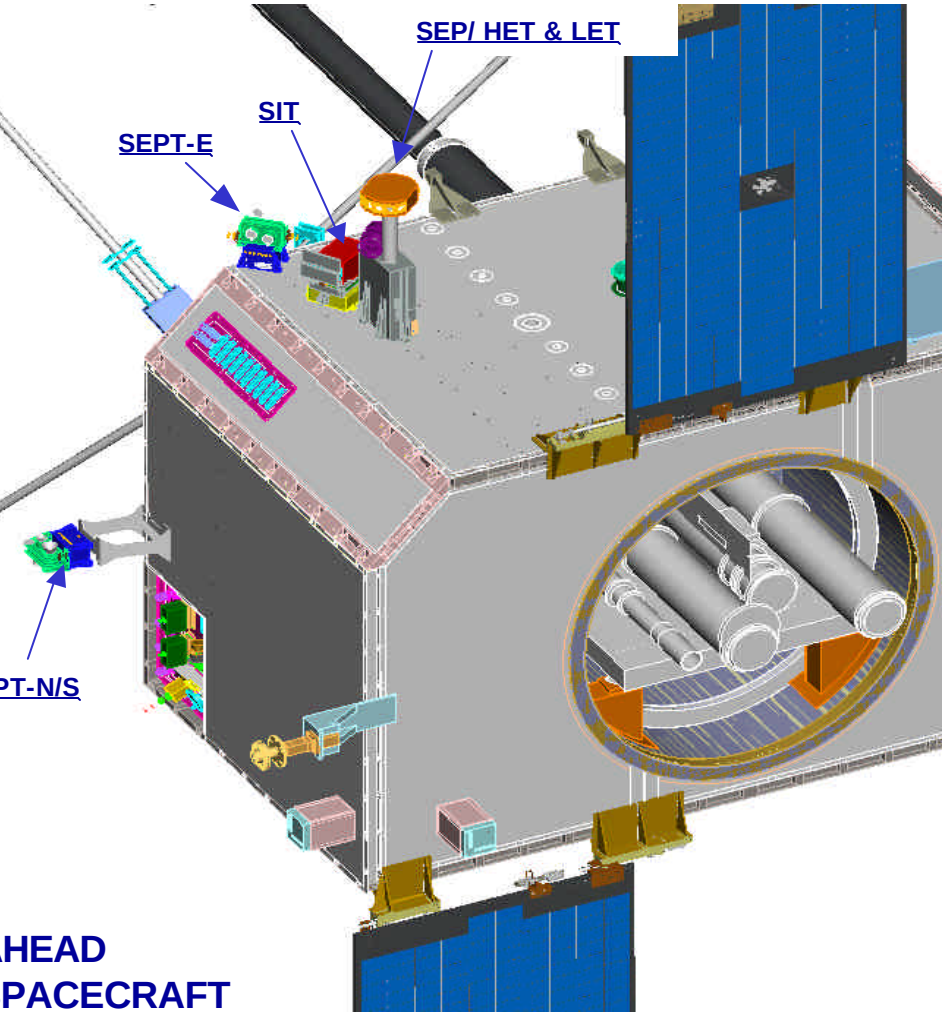
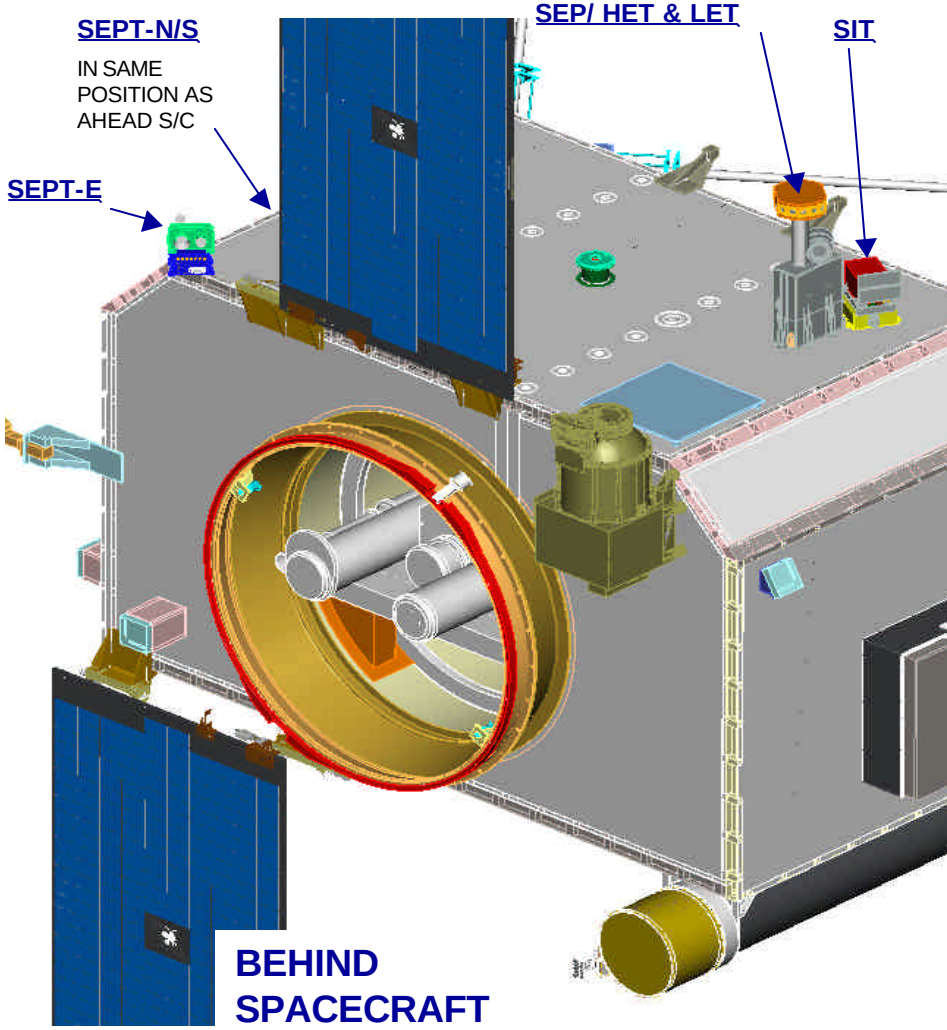
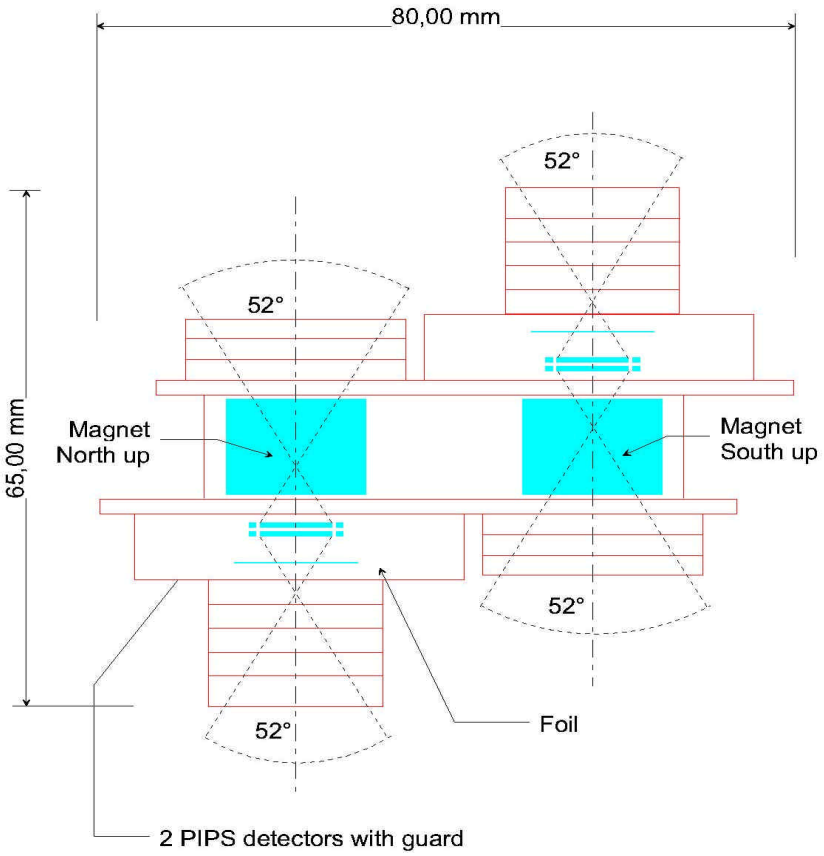
SEP Instrument Suites





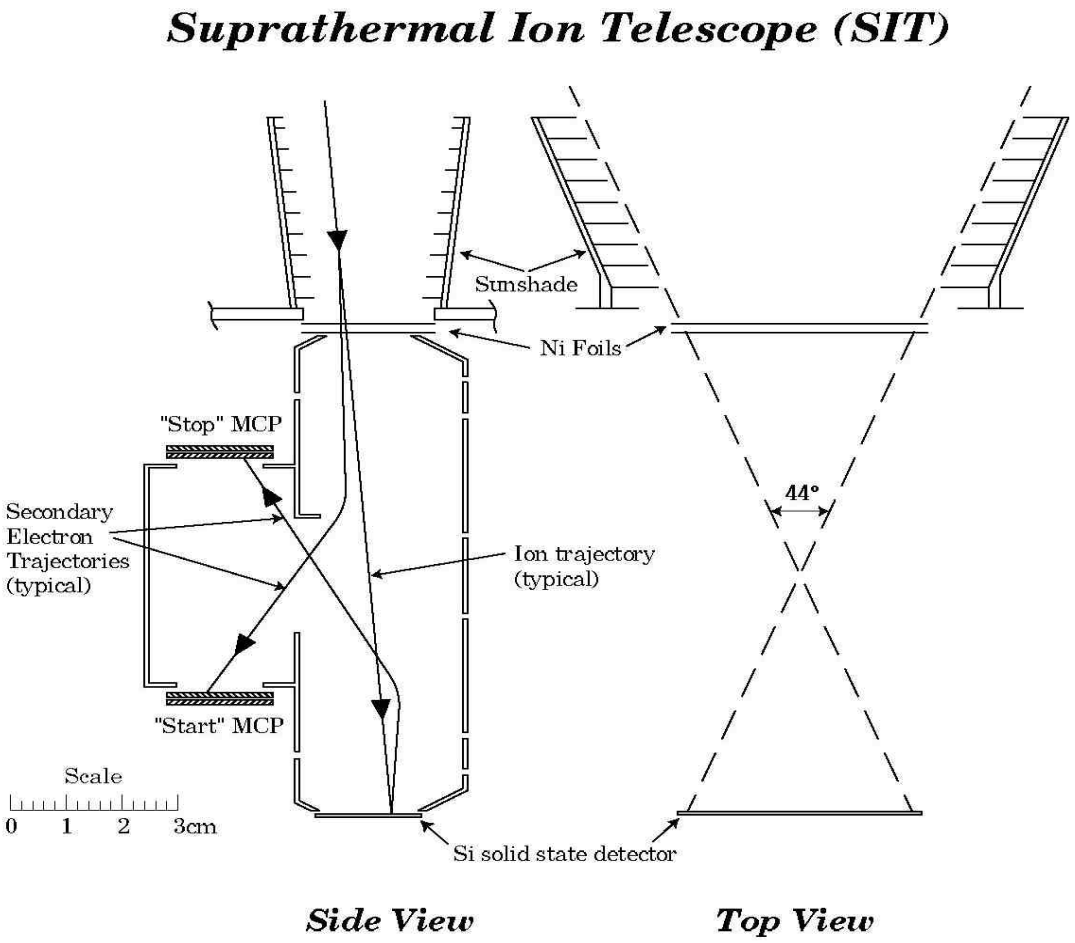
Solar Electron Proton Telescope (SEPT) Schematic



Bottom View!

SEPT OVERVIEW

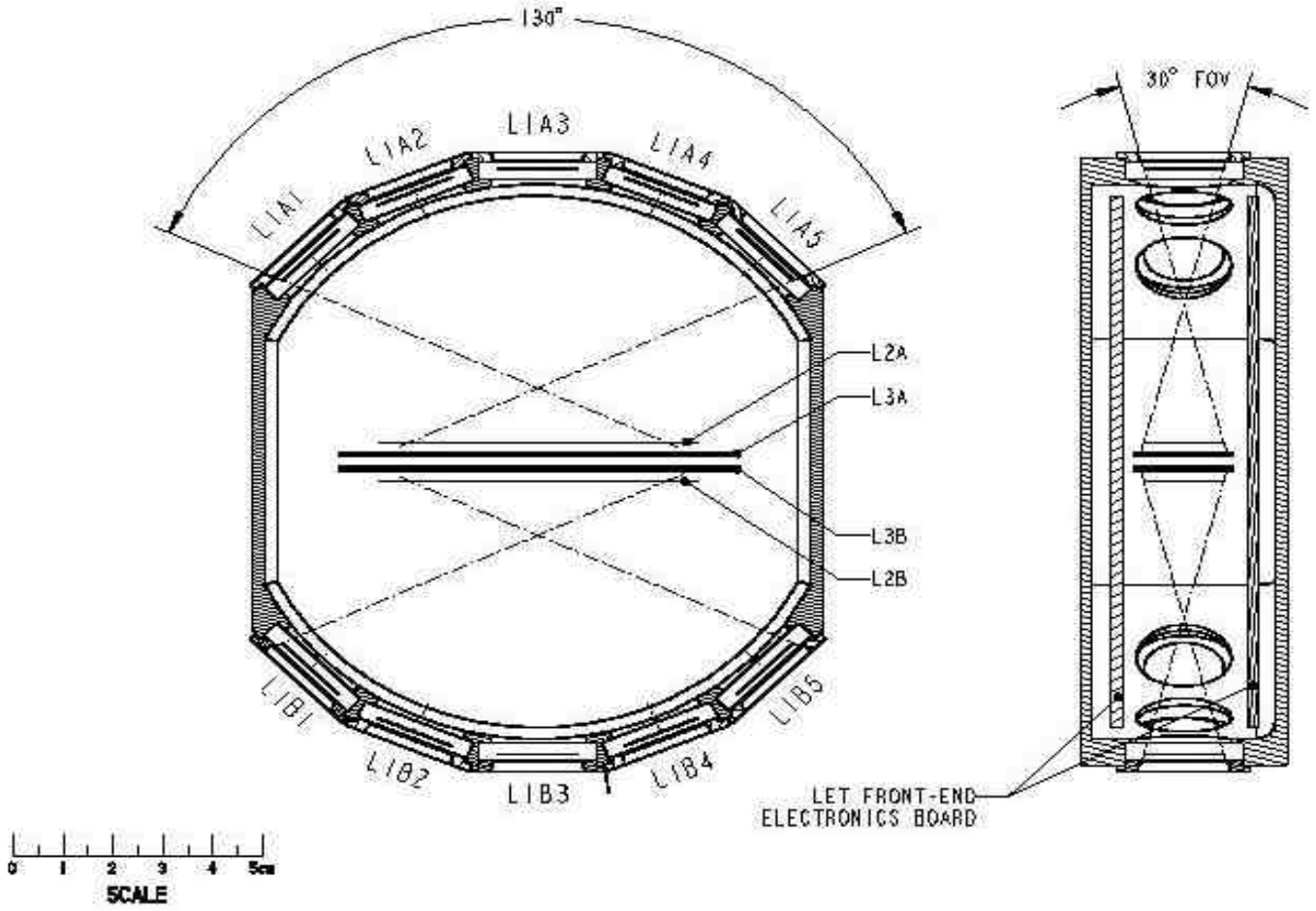
- Solid-state detectors subject to degradation if exposed to volatiles; estimate dry N2 purge rate of 0.7 l/hr for each of SEPT-E and SEPT-NS up to launch.
- SEPTs include apertures with no protective foils and hence direct exposure of detector surfaces to space.
- Four 1-time doors on each of SEPT-E and SEPT-NS (TiNi pin-pullers). Purpose is to protect from acoustic noise during launch and from incident sunlight during the off-pointing maneuvers prior to mission configuration.
- High field magnet in each SEPT is designed to have very low fringing field. Subject to corrosion if subjected to humidity > 50% or to acid/alkaline fumes.
- SEPT will be assembled at Kiel University in Germany
- Kiel will follow cleanliness procedures earlier followed for a similar instrument on SOHO


Suprathermal Ion Telescope (SIT)
Sunshade
Ni Foils
"Stop" MCP
Secondary
Electron
Trajectories
(typical)
Ion trajectory
(typical)
44°
"Start" MCP
Scale
0 1 2 3cm
Si solid state detector
Side View
Top View

SIT OVERVIEW

- Surface Barrier Solid-State Detector is extremely sensitive to volatiles
- Surface Barrier Solid-State Detector can never be allowed to exceed 35 degrees C (i.e. cannot bake out)
- Surface Barrier Detector surface cannot be cleaned except by gentle air flow over surface and long-term thermal vacuum testing
- Microchannel Plate (MCP) Detectors sensitive to dust, humidity, hydrocarbons (NVR)
- High Voltage (up to 4.2 kV) also must remain clean to avoid arcing (highest voltage in SEP by far)
- Purged with outflow through labyrinth to open hole at the front of the telescope
- 1-time door for acoustics and sun-avoidance early in mission
- SIT components other than detectors will be cleaned and baked out prior to assembly
- The SIT Telescope will be assembled at GSFC in a Class 10K clean room on a class 1K clean bench
- The SIT electronics will be assembled in a Class 100K clean-room on a Class 10K clean bench at the University of Maryland
- The exterior of SIT will be cleaned prior to delivery to APL to the VC+HS+UV level
- Thermal blankets will be made and installed at APL

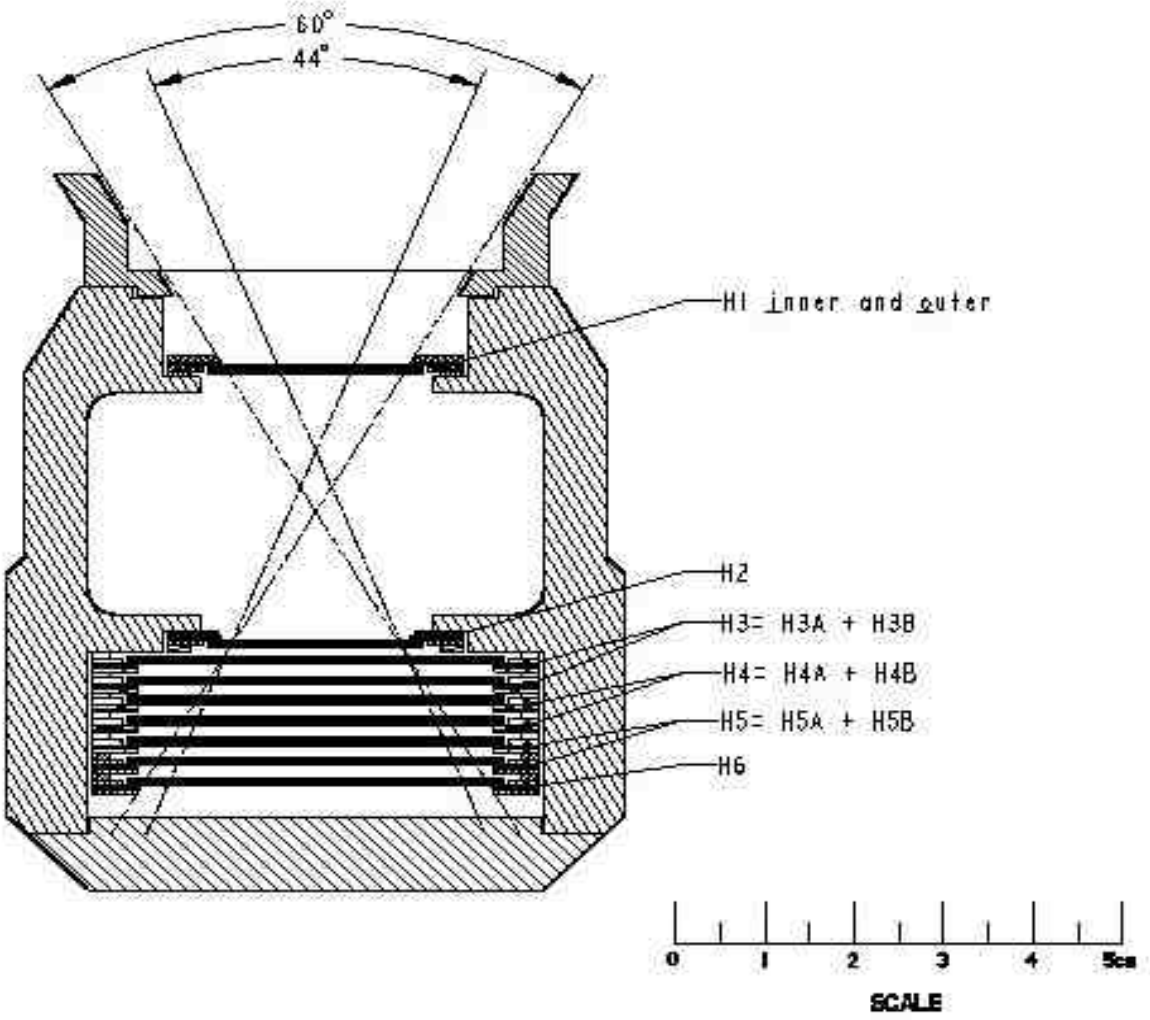
Low Energy Telescope (LET) Schematic



LET OVERVIEW

- All detectors are ion-implanted solid-state detectors
- Detectors must not exceed + 40 degrees C
- Dry nitrogen purge required
- LET components other than detectors will be cleaned and baked out prior to assembly
- Detectors will be primarily kept in a dry Nitrogen or vacuum environment and handled only with gloves
- LET will be assembled in a Class 100K clean-room on a Class 10K clean bench at Caltech
- The exterior of LET will be cleaned prior to delivery to APL to the VC+HS+UV level
- Thermal blankets will be made and installed at APL

High Energy Telescope (HET) Schematic



HET OVERVIEW

- All detectors are ion-implanted solid-state detectors
- Detectors must not exceed + 40 degrees C
- Dry nitrogen purge required
- HET components other than detectors will be cleaned and baked out prior to assembly
- Detectors will be primarily kept in a dry Nitrogen or vacuum environment and handled only with gloves
- HET will be assembled in a Class 10K clean-room on a Class 1K clean bench at GSFC
- The exterior of LET will be cleaned prior to delivery to APL to the VC+HS+UV level
- Thermal blankets will be made and installed at APL

SEP Contamination Issues

- **Contamination Sensitivity:**
  - **Solid-State Detectors and Microchannel Plates are very sensitive to volatiles. Recent changes to the STEREO Contamination Control Plan (section 7.4, Draft Revision A) have addressed our concerns in this area, however solid-state detector sensitivity is not restricted to hydrocarbons (line 6 of section 7.4). For example, ammonia (NH3) is particularly dangerous.**
  - **Volatiles can be used near the SEP instruments only when the instruments are under purge. Such volatiles must be strictly controlled, with quantities limited to no more than necessary. Only methyl and isopropyl alcohol are approved cleaning solvents. It is required that all of our telescopes be kept under continuous dry Nitrogen purge (LN2 boil-off is fine) up until launch with only a few, limited exceptions.**
  - **Purge lines are to be of teflon. Dry Nitrogen should be provided by APL in a specified pressure range (~ 15 psi; we will provide our own in-line restrictors).**
  - **Soldering near the SEP instruments requires that the instruments be under purge, and in no case shall be done without an appropriate fume exhaust system.**
  - **All our telescopes will have venting ports. These will vent purge gas during I&T and will vent the telescopes during launch.**

SEP Contamination Issues, cont.

- **Fabrication & Test:**
  - Mechanical fabrication (mostly in Aluminum) will use no cutting oils.
  - So far all planned materials meet outgassing requirements.
  - All mechanical components other than detectors shall be cleaned and baked out prior to assembly.
  - Detectors will be maintained in a controlled area and shall be handled only with gloves from the time that we receive them. They will be kept under dry nitrogen purge except when they are being readied for or transported to a test. They cannot in general be raised in temperature above + 35 degrees C (SIT) or + 40 degrees C (all others). Assembly into telescopes will be performed by personnel wearing gloves, face masks and lab coats on a clean bench.
  - Electronics shall be assembled, tested and reworked in a controlled environment by technicians wearing ESD-safe gloves (whenever possible, w/o impeding dexterity) and lab coats. After final assembly the boards will be cleaned, conformally coated, and baked out. After each cleaning or bake-out the test and assembly personnel shall handle the boards with ESD-safe gloves.
- **I&T Temperature & Humidity:**
  - Require normal room temperature to be in the range 15 – 25 degrees C.
  - To prevent ESD damage due to low humidity, NASA guidelines shall be followed (typically, no less than 35% humidity when work is being performed on the S/C or flight electronic sub-assemblies).

SEP Contamination Issues, cont.

- We don't know how to relate volatile contamination requirements in the terms of MIL-STD-1246 because the latter refers to quantities in terms of micrograms/cm2 whereas our concerns have to do with chemical reactivity with detector surfaces
- Our solid-state detectors cost thousands of $ each so it is impractical to test which of myriad solvents might be OK or not
- Prior experience on numerous missions such as ACE shows that restricting solvents near the spacecraft to only methyl and isopropyl alcohol in modest amounts and keeping our instruments under purge is adequate to protect our detectors

STEREO/IMPACT/SEP Thermal Surfaces Visible With Doors Closed

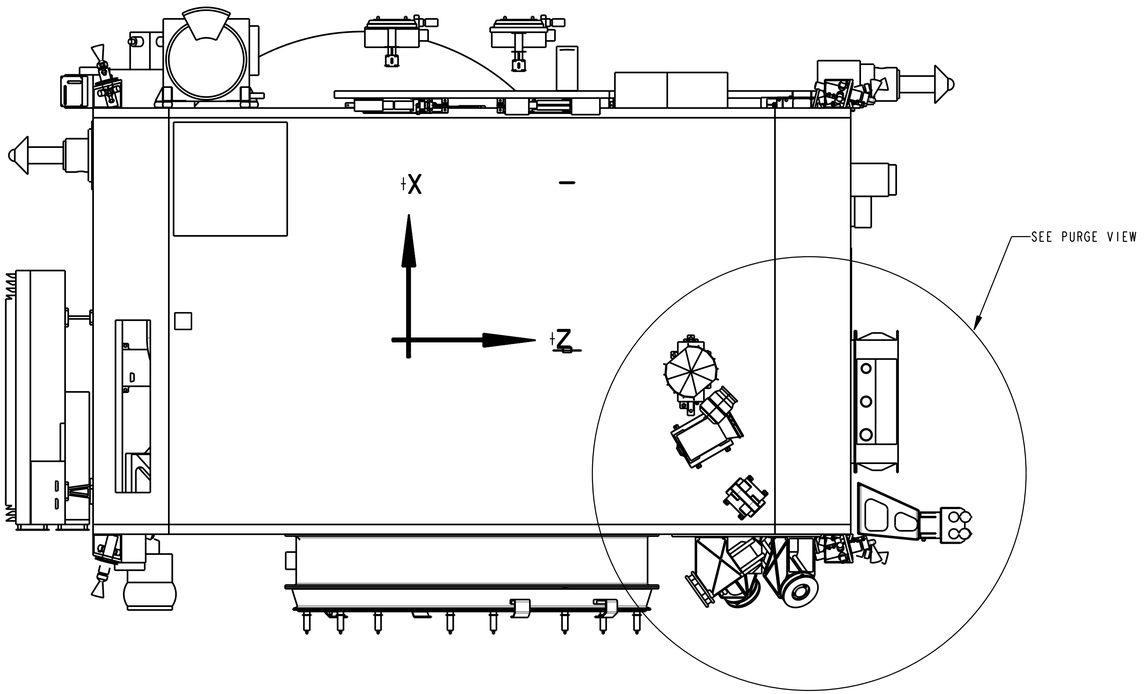
	Thermal Blanket	Adhered Kapton	Black Paint	NS43C White Paint
SEPT-N/S	X		X	X
SEPT-E	X			X
SIT	X	X		
LET	X	X		
HET	X			
Main SEP Box	X	X		

Notes: Thermal Blanket outermost layer has ITO (for conductivity) over GSFC Composite Coat
Adhered Kapton has ITO (for conductivity) over GSFC Composite Coat
(could also apply coatings directly onto Aluminum surface)

SEP Purge Flow Directions

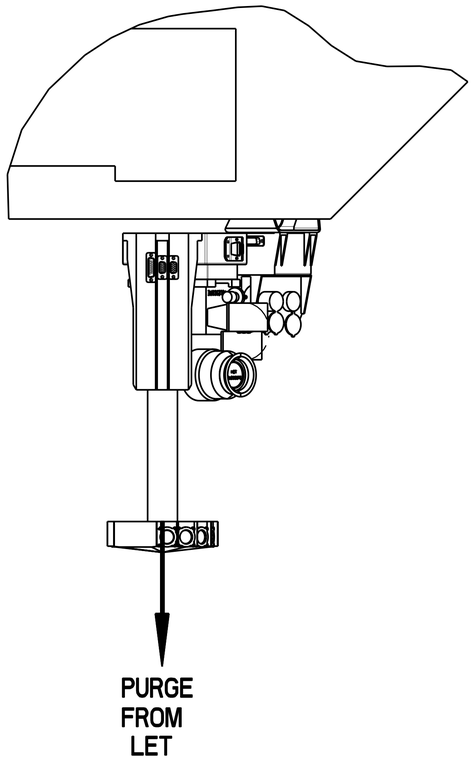
- **Illustrated in separate file: purge-drawing1.pdf**

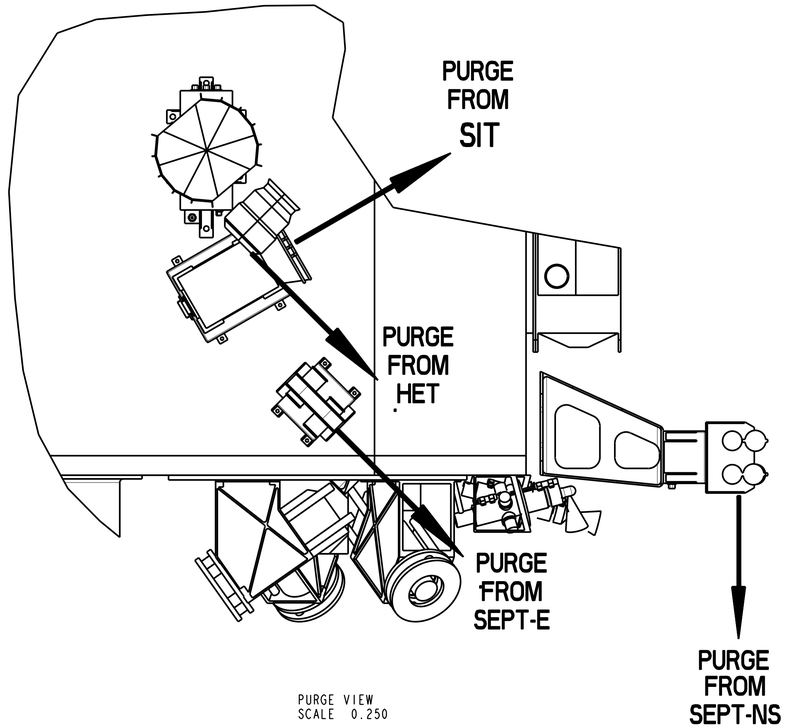
EXHAUST PURGE FLOW	
HET	45° BETWEEN -X AND +Z
LET	+Y DIRECTION
SEPT-E	45° BETWEEN -X AND +Z
SEPT-NS	-X DIRECTION



CURRENT FLOW
DIRECTION OF
OF EXHAUST PURGE
FOR AHEAD SPACECRAFT

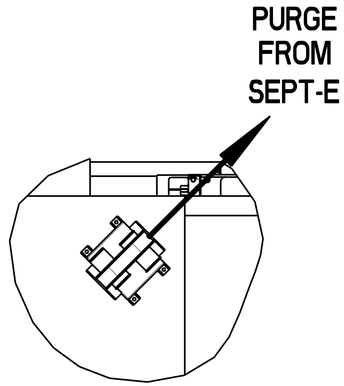
PLOT DATE: 09-Nov-01



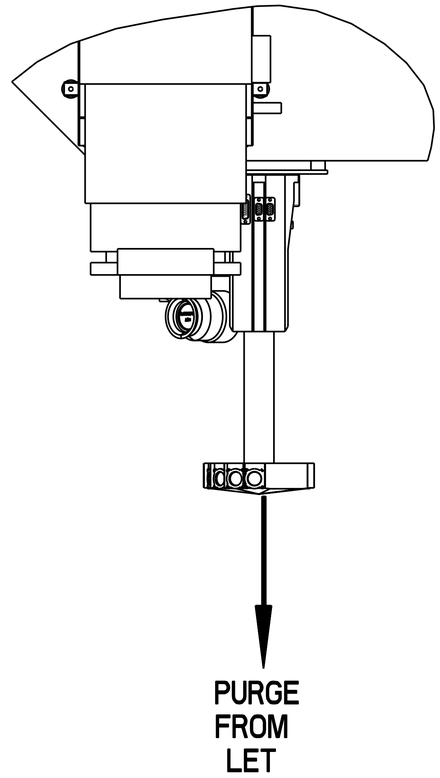


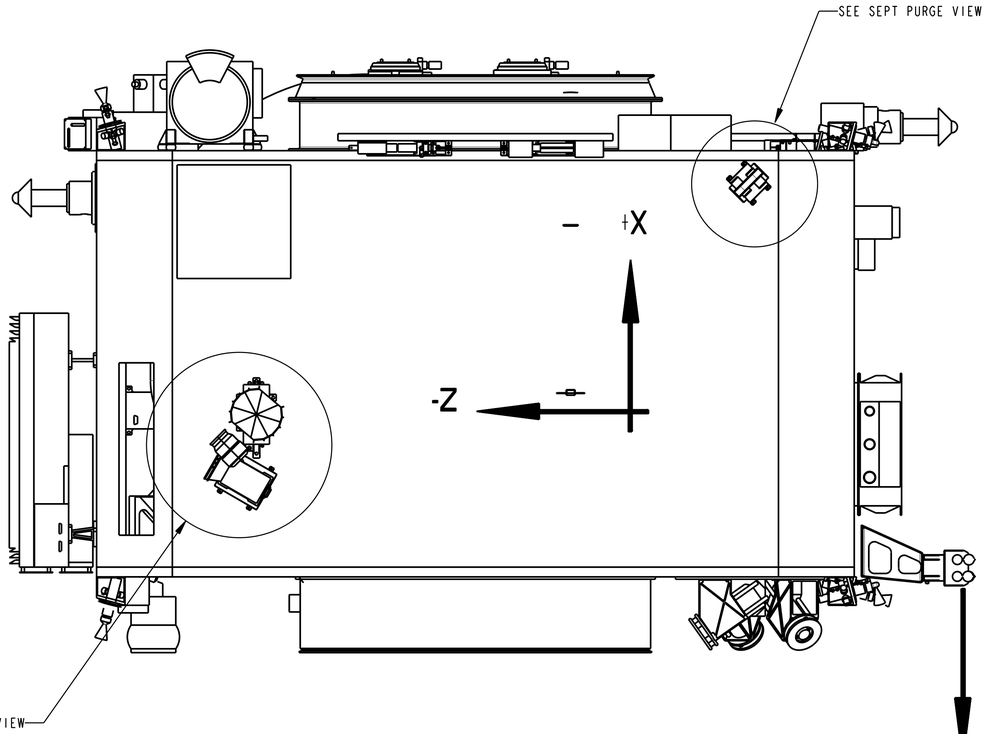
PURGE VIEW
SCALE 0.250

EXHAUST PURGE FLOW	
HET	45° BETWEEN -X AND -Z
LET	+Y DIRECTION
SEPT-E	45° BETWEEN +X AND +Z
SEPT-NS	-X DIRECTION



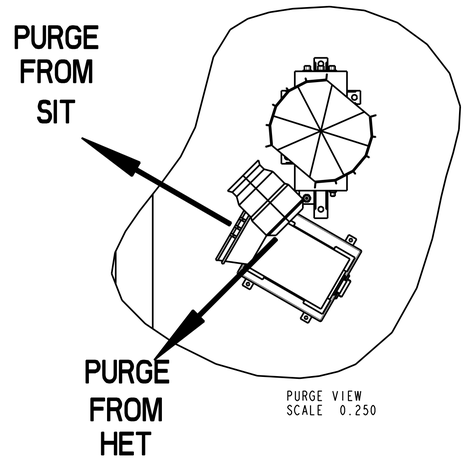
SEPT PURGE VIEW
SCALE 0.250





CURRENT FLOW
DIRECTION OF
OF EXHAUST PURGE
FOR BEHIND SPACECRAFT

PURGE
FROM
SEPT-NS



PURGE VIEW
SCALE 0.250

PLOT DATE: 09-Nov-01