TIMED

Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

TIMED SPACECRAFT PURGE SYSTEM

Albert C. Sadilek
Johns Hopkins University
Applied Physics Laboratory
Tel: 301-953-5369 Fax: 301-953-6556
email: albert.sadilek@jhuapl.edu

TIMED SPACECRAFT PURGE SYSTEM

Purging System to provide Instruments with Purge Gas Flow during Integration, Testing, and Transporting of S/C up to Launch.

Purging System will meet all NASA and WSMC Safety Criteria.
- Component Overpressurization Safety Factor of 4/1.
- Redundant Safety Pressure Release Valves in Gas Line.
- Check Valves in hose connections will seal all disconnected Lines and prevent backflow of Purge Gas.

Contamination-Sensitive Instruments shall have a Purge Gas Flow.
- Instrument Internal Pressure desired to be higher than 5 Torr (0.1 psid) to prevent entrance of Contaminants.
- Internal Gas Volume changed in the Purge Time listed In Chart.
- Purge Gas Flow to be sonic thru Orifice (Choke Flow).
  - Maintains constant volume gas flow to Instruments.
- Independent of other users on the Manifold.

TIMED SPACECRAFT PURGE SYSTEM

Purge System GSE will constantly monitor purity of gas.
- Instrumentation will monitor H_2O and O_2 content, pressure, and temperature of Nitrogen Purge Gas.
- Alarm will sound if monitored Parameters go Out-of-Range.
- Response time will be less than Two Hours to correct problem.

Purge Gas will be Ultra High Purity (99.999%) Nitrogen or better.
- Liquid Nitrogen Tank boiloff is Research Grade purity.
  - Water vapor is 0.05 ppm < 1 ppm, O2 is 4 ppm < 5 ppm.

Purge Gas sources in Bldg. 23 have been tested for Contaminants
- Space Simulation Lab Liquid N_2 Tank is source of Purge Gas:
  - 0.30 ppm O_2, 0.1 ppm THC, -120°F dew point (0.3ppm)
- Purge Gas Lines in Bldg. 23 Clean Rooms are acceptable purity:
  - High Bay Clean Room (Spacecraft Purge Gas source)
  - Class 100 Clean Rooms (Instrument Purge Gas Source)

TIMED SPACECRAFT PURGE SYSTEM

Purge Gas Flow Rate is 1.76 CFM (49.9 slpm)

- SSL LN_2 Tank boiloff available at APL during S/C Integration
  - 27 to 30 psig boiloff pressure from tanks
  - 14.5 psig required in Purge Gas Manifold
- LN_2 Dewars can be used in the field
  - 160 liter Dewar lasts 37 hours at 1.76 CFM
  - 450 liter Dewar lasts 105 hours at 1.76 CFM

Purge System shall have a .01 micron filter in-line to protect Sensors.

- Filter located at Purge Suitcase Outlet connection to Spacecraft.
- Purge Gas line from LN_2 tank to Clean Room may shed Particles.
- Shutoff Valves and Regulators can be sources of Particulates.
- Last Chance 17 micron Filter at Purge Suitcase Inlet Connection.

TIMED SPACECRAFT PURGE SYSTEM

Purge Gas is distributed to Instruments using Spacecraft Manifold.
Fittings and Teflon Lines connect Manifold to Instruments.
Each Line will have an Individually sized Orifice/Restrictor to meter specific flow to individual Instruments.

Spacecraft Purge Manifold will have two inlet points;
One for ground purging, located TBD.
One flyaway fitting, located on aft bulkhead of Spacecraft.

Last-Chance 17 micron Filter is at both inlets to S/C Manifold.

TIMED SPACECRAFT PURGE SYSTEM

Vent Valves/Filters shall be incorporated into Instrument Housings.
Valves are required to minimize Purge Gas usage and
to block contaminants from entering the Instruments.
Valves shall be sized to prevent overpressure during launch.
Multiple valves can be incorporated into each housing.

Instruments not using Vent Valves should vent through Outlet Filters.
Filters will meter gas exit flow to set Instrument internal pressure.
All backfill gas is then filtered to prevent Sensor contamination.
Filters will protect Instruments from barometric pressure changes
and will prevent overpressure during Launch.

Housings that are too leaky to maintain a purge pressure of 0.1 psig
will not have Vent Filters installed.

TIMED

Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

TIMED SPACECRAFT PURGE SYSTEM

Instrument Name	Internal Volume (ft^3)	Purge Time (min)	Required Air Flow (CFM)/(slpm)	Orifice Dia. (inch)	Purge Pressure (psid) to Instrument	'Vent Valve Pressure (psid)	
						Crack	Flow
SABER.	0.89	1.8	0.50 / (14.2)		4.0 psig	0.15	0.20
SEE	1.7	5	0.34 / (9.6)		0.04 to 0.1 psig		
GUVI.	1.5	5	0.30 / (8.5)		0.04 to 0.1 psig		
TIDI							
Profiler.	2.5	5	0.50 / (14.2)		0.04 to 0.1 psig		
Telescope 1	0.14	5	0.03 / (0.85)		0.04 to 0.1 psig		
Telescope 2	0.14	5	0.03 / (0.85)		0.04 to 0.1 psig		
Telescope 3	0.14	5	0.03 / (0.85)		0.04 to 0.1 psig		
Telescope 4	0.14	5	0.03 / (0.85)		0.04 to 0.1 psig		

Total GN_2 Flow = 1.76 CFM (49.8 slpm) @ STP;
Manifold Pressure = 14.5 psig in ½" O.D. manifold tubing

TIMED SPACECRAFT PURGE SYSTEM

At APL, during Spacecraft Integration & Testing, purge gas source will be vaporized LN_2 from SSL Storage Tank

During Spacecraft transport, Purge Gas source is cryogenic dewar
Each 450 liter LN_2 Dewar will give 105 hour Purge Gas supply.
LN_2 Dewars expected to be used for air and ground transport.

At GSFC and at VAFB, Purge Gas supplied from 450 liter Dewars.
At GSFC, locate Dewar adjacent to Spacecraft,
and plumb gas through flexhose to S/C.
At VAFB Bldg 1610, locate dewar adjacent to Spacecraft or outside building, and plumb gas thru flexhose to S/C.
At VAFB Launch Pad, locate dewar on ground near Launch Vehicle. Plumb gas up Umbilical Tower to Spacecraft.

TIMED PURGE SYSTEM STATUS

1. Two existing Purge Gas Monitor suitcases will be used for the TIMED purge system. Presently, they are being refurbished for the FUSE program and will be ready for use during the TIMED Spacecraft Instrument integration.
2. Two new 450 liter LN_2 dewars are being procured, one on the TIMED budget and one on the FUSE budget. Handling Carts from the MSX program have been refurbished for the dewars.
3. A third 160 liter LN_2 dewar and handling cart is available from the ACE program as an emergency standby dewar.
4. The TIMED Spacecraft purge manifold and tubing runs have been defined. Support bracket locations and actual purge components to be mounted on the Spacecraft must be selected.
5. The purge gas flow rate versus Instrument internal pressure must be measured for all Instruments. The individual metering orifices must be sized and ordered.

TIMED PURGE SYSTEM STATUS (Continued)

6. LN_2 dewars can be transported on military aircraft, but a waiver must be obtained to allow the purge gas to be vented inside the cargo area. Also, emergency burst discs on the dewars must be plumbed overboard.
7. At VAFB (Building 1610?), LN_2 Dewars can be located inside the building, but operationally it is better to locate them outside the building. Hoses will carry the purge gas to the spacecraft.
8. At the Launch Pad, LN_2 Dewars will be positioned on the ground at the base of umbilical tower, with 1/2" OD stainless steel tubing carrying the purge gas up the tower.
9. The fitting type for the purge gas connection on the shipping and transportation containers must be defined.
10. Purge gas operations must be incorporated into spacecraft operational and handling procedures.