Propulsion

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System Level Requirements

- Provide forces and torques for tip-off rate negation and 3-axis momentum dumping (Presently no requirement for injection correction, de-spin or orbit adjust forces or torques)
- Provide sufficient expendables for a five year mission including a 10% leakage allowance
- Total external leak rate $\leq 1 \times 10^{-5}$ scc/s
- Provide an indication of propellant remaining
- Meet the safety requirements of EWR-127-1

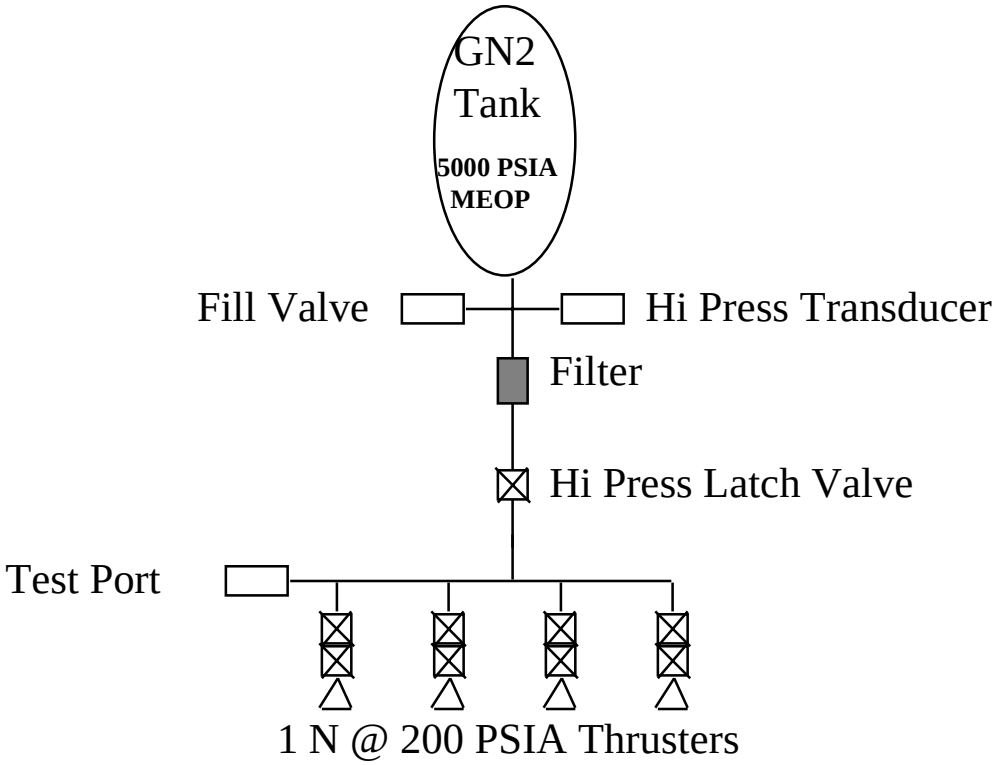
Subsystem Flowdown Requirements

- Operate with 28 ±6 VDc
- Operate over a temperature range of 0 to 40°C
- Operate after exposure to the launch environments

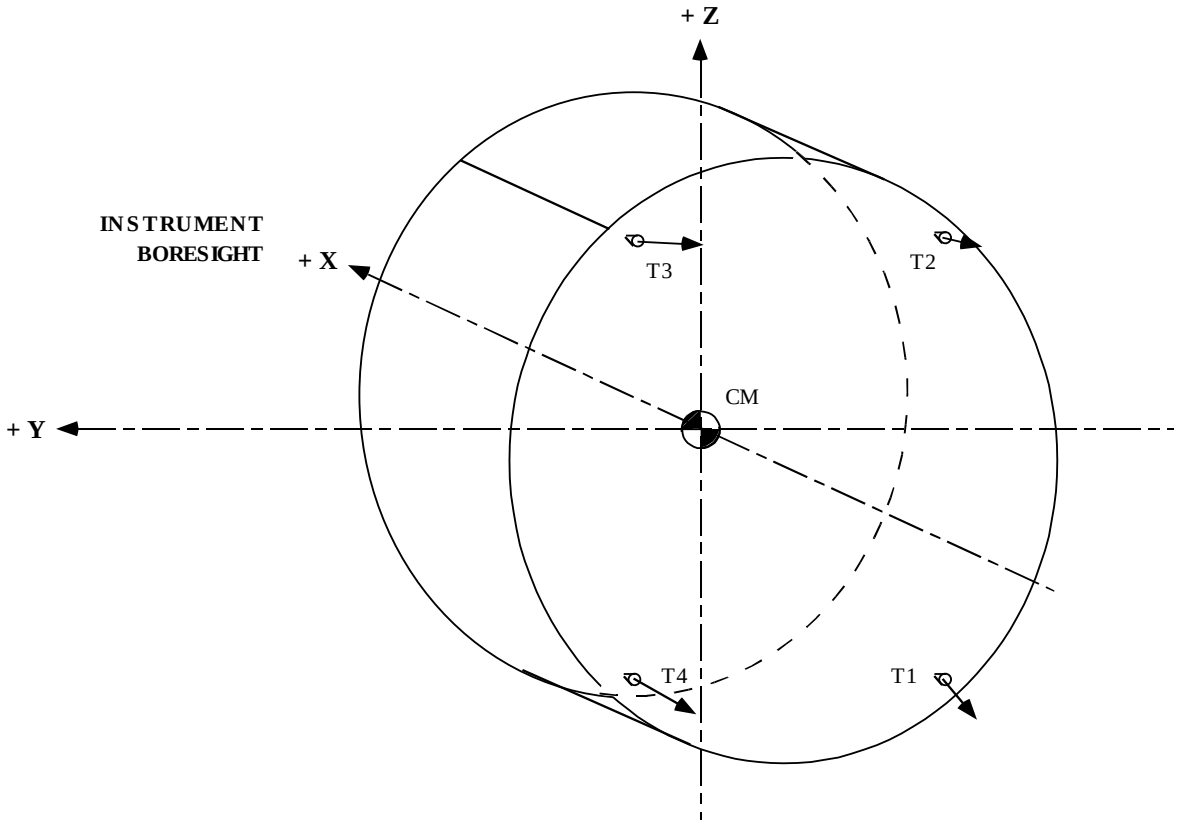
Subsystem Derived Requirements

- Schematic and thruster arrangement per the next two charts
- Minimum tank volume – 8.0 liters (490 in^3)
- Nominal gas storage pressure – 4700 psia
- Maximum expected operating pressure (MEOP) – 5000 psia
- Max min thrust level – 5.0 to 0.2 N (1.1 to 0.05 LB_f)
- Common inlet pressure thruster-to-thruster thrust tolerance ± 3.0%
- Research grade GN2 gas per Mil-P-27424
- Cleanliness requirements (To assure leak tight integrity)
  - All components and manifolds cleaned to Level 100A of ATC-STD-4940E
  - All manifolds internally electropolished
  - Valve savers on all fill valves prior to launch
  - Inlet and outlet filters on all thruster valves
- If redundancy is required, increase to eight thrusters (allowable leakage must double), then two latch valves, then two pressure transducers

Subsystem Schematic



Baseline Thruster Arrangement



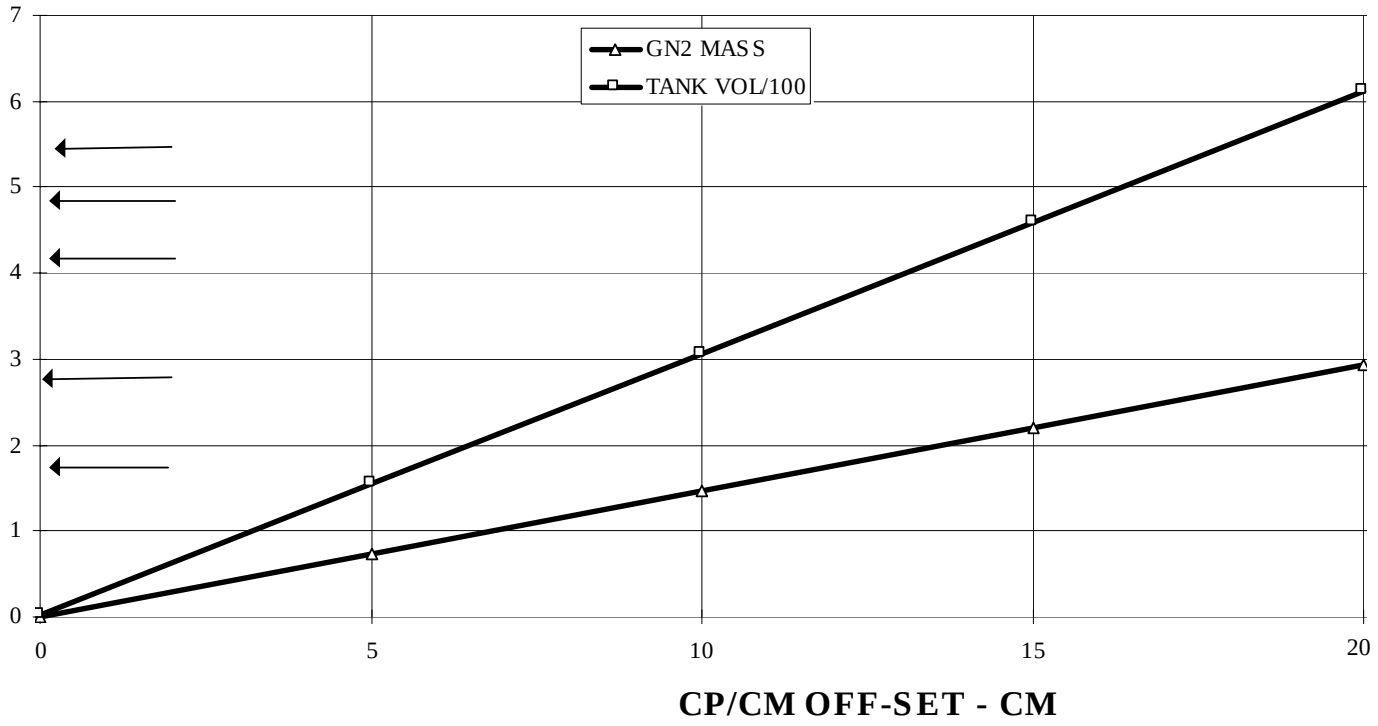
15° double canted 4 thruster set provides pitch, yaw, roll and 1 axis ΔV

Thruster	Torque	Axis
T2T3	+P	Around Y
T1T4	–P	Around Y
T1T2	+Y	Around Z
T3T4	–Y	Around Z
T2T4	+R	Around X
T1T3	–R	Around X

Thruster	Force
T1234	+X

- Requires thruster matching and alignment to minimize cross coupling
- Torque capability around X axis is diminshed. Other axis have two thruster torque

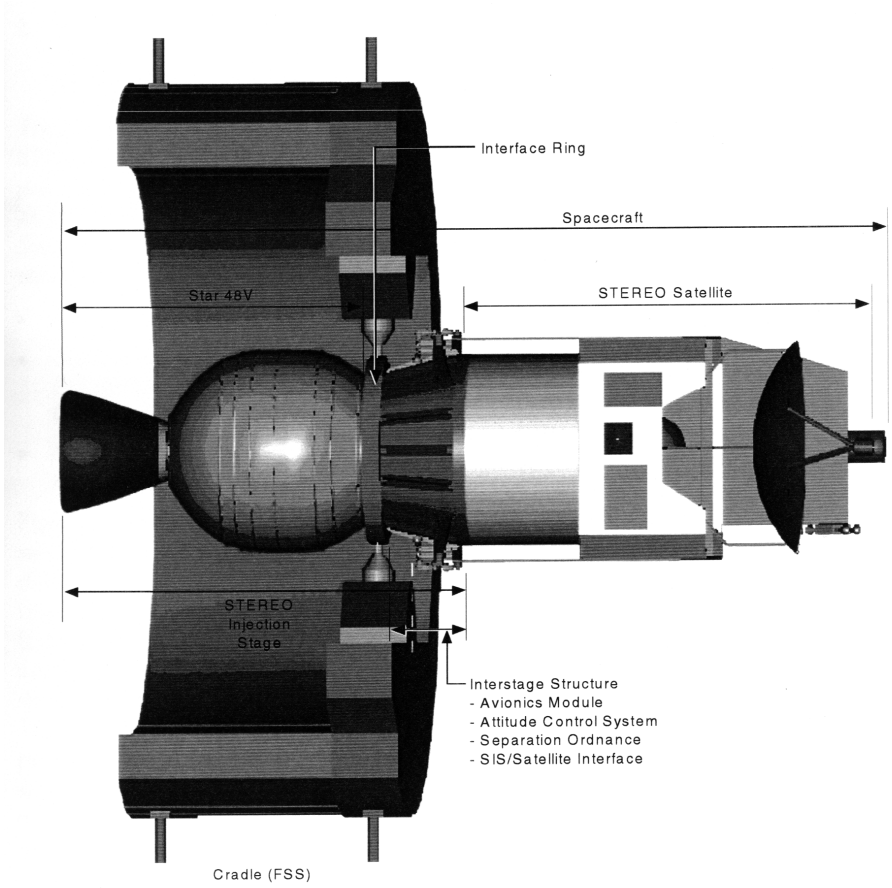
Tank Volume and GN2 Mass versus CP/CM Off-Set
(Five years, 4.6×10^{-6} N/m^2 Solar Press, 5000 PSIA MEOP)



Keys To Meeting the Underlying Low Cost Requirement

- Minimum number of components
- Flight qualified, off-the-shelf design components
- Build clean, keep clean to minimize late leaks
- Factor of safety ≥ 4.0 during all testing to minimize safety documentation
- Buried, protected graphite composite overwrapped pressure vessel installation to minimize range safety documentation requirements
- RFP's to at least three qualified vendors to assure competitive bids

Cargo Element Nomenclature



Solar Terrestrial Relations Observatory (STEREO)
Pre-Phase-A Requirements Review