

First-Stage Tanks for Kistler K-1 Launch Vehicle



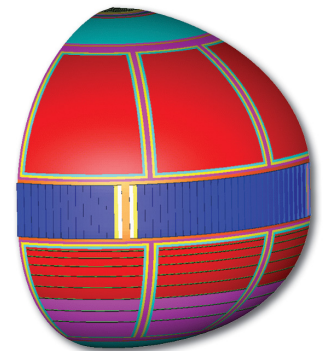
Case Study

OVERVIEW

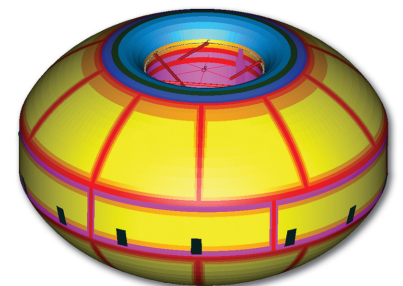
The Kistler K-1 was a reusable launch vehicle consisting of two stages: a Launch Assist Platform (LAP) and an Orbital Vehicle (OV), both using liquid oxygen (LOX)/rocket propellant (RP) engines. ATA took responsibility for the design and analysis of the LAP LOX tank before it became a schedule-critical item. ATA carried out a series of trade studies to explore different design concepts to satisfy material availability and manufacturing constraints. After Lockheed Martin Space Systems (LMSS) was awarded the tank contract, ATA continued the design effort directly for them and used an analysis-driven design approach to develop a design that could meet all of the structural, manufacturing, and transportation requirements.

TASKS PERFORMED & KEY OUTCOMES

- Developed early design concepts for the LOX tank barrel and domes.
- Performed thin shell stress analysis of the tanks subject to internal pressure and quasi-static G loads.
- Recommended suitable factors of safety and allowable stress values for all areas.
- Carried out linear and/or nonlinear buckling analysis of all compression components.
- Performed detailed analysis of flanged connections.
- Analyzed the LOX tank manhole cover design concept used by LMSS on the Space Shuttle external tanks and checked the design for stresses and sealing requirements for use in the K-1 tank configuration.
- Provided analysis in support of weight reduction studies for all components.
- Performed detailed analysis to identify lower-weight orthogrid configurations for the tank skirts.



LAP LOX tank



LAP fuel tank