Development of a Warm-Gas Butane System for Microsatellite Propulsion

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Overview

- Conceptual Design
- Analysis and Detailed Design
- Component Selection and Mechanical Configuration
- Current Testing
- Demonstration
- Future Work
Conceptual Design Process

- Lifetime
- Orbit
- Volume
- Mass
Conceptual Design Process

- Lifetime
- Orbit
- Volume
- Mass

Decay Analysis

Delta-V
Conceptual Design Process

- Lifetime
- Orbit
- Volume
- Mass

Decay Analysis
- Delta-V

Packaging Analysis
- Specific Impulse
Conceptual Design Process

- Lifetime
- Orbit
- Volume
- Mass

- Decay Analysis
- Packaging Analysis

- Delta-V
- Specific Impulse

Requirement Flowdown
Conceptual Design Process

- Lifetime
- Orbit
- Volume
- Mass

- Decay Analysis
- Packaging Analysis

- Delta-V
- Specific Impulse

- Requirement Flowdown

- Cost
- Materials
- Exhaust Temperature

- Conceptual Design
Conceptual Design Process

- Lifetime
- Orbit
- Volume
- Mass

- Decay Analysis
- Packaging Analysis

- Delta-V
- Specific Impulse

- Requirement Flowdown

- Cost
  - Materials
  - Exhaust Temperature

- Safety
  - Hazards

- Conceptual Design
Conceptual Design

Legend:
- S: Servicing Valve
- T: Temperature
- P: Pressure
- S: Solenoid
- Electric Heater

Butane
Analysis and Detailed Design
Analysis and Detailed Design
Analysis and Detailed Design

- Conceptual Design
  - Butane
- REFPREP
  - Warm Gas
  - Fluid Properties
- Thermal Analysis
  - Tank Temperature
- Matlab Model
Analysis and Detailed Design

Conceptual Design

Butane

Warm Gas

REFPROP

Fluid Properties

Matlab

Model

Tank Temperature

Thermal Analysis

Required Power Component Sizing

Detailed Design
Analysis and Detailed Design

- Conceptual Design
  - Butane
- REFPROP
  - Fluid Properties
- Warm Gas
- Thermal Analysis
  - Tank Temperature
- Matlab Model
  - Required Power Component Sizing
- Detailed Design
  - Feasibility Assessment
    - Performance Requirements
    - Mission Operations Analysis
    - Available Power

Andrews Space
Mechanical Configuration

- Focus on COTS components
  - Tanks, plumbing, heating elements, valves, sensors, nozzle
- Straightforward machining
  - HEX and Manifold are aluminum boxes
- Minimal complex manufacturing
  - Titanium bracket
Heat Exchanger Detail

Titanium Mounting Bracket

Stainless Steel Plate

Alumina Insulation

Ceramic Heaters

Machined Aluminum Block
Test Platform
Demonstration