



***PERFORMANCE OF A 2500 LBF  
HYDROGEN PEROXIDE –  
POLYETHYLENE HYBRID  
6/30/00***

# Overview

- Introduction
- Test Schematic
- Hybrid Chamber Configuration
- Test Data
  - Video
  - Measured Mean Chamber Pressure
  - Waterfall Plot
  - Reduced Motor Data
- Comparison of Fuel Regression vs Mass Flux with Subscale Data
- Conclusions

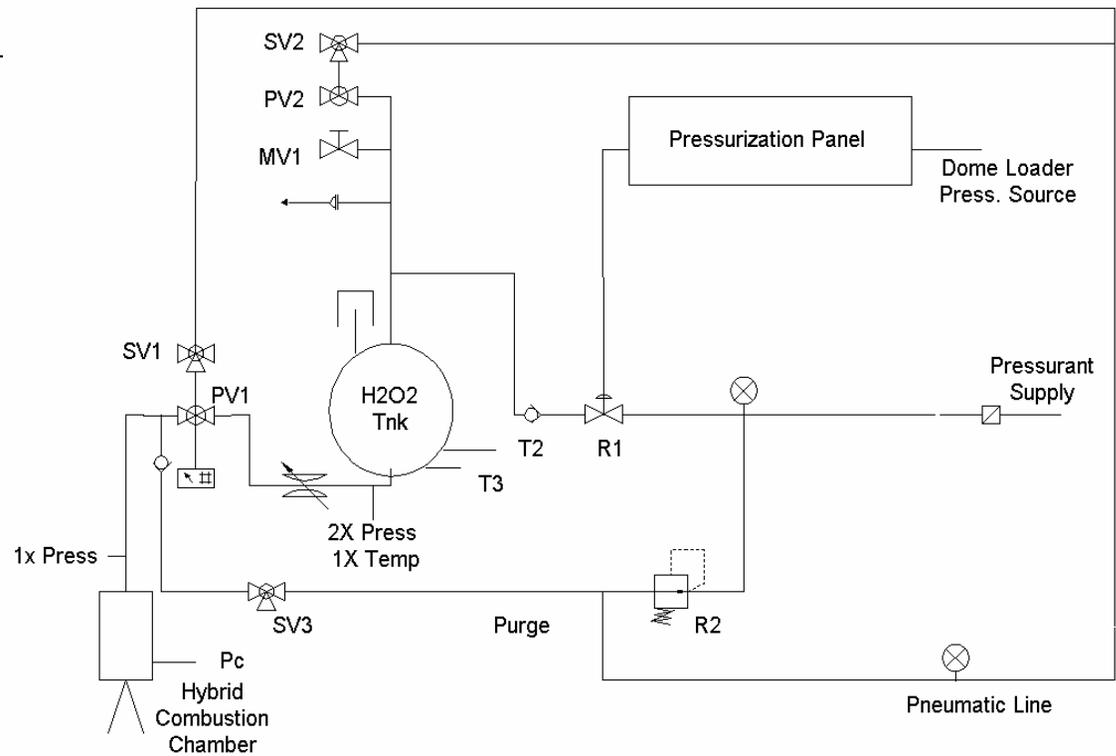
# *Introduction*

- Single 4 Second Burn of 2500 lbf Class Hybrid
  - 85% H<sub>2</sub>O<sub>2</sub> – Ultra High Molecular Weight PE Hybrid
  - H<sub>2</sub>O<sub>2</sub> Decomposed by Catalyst Bed
  - Fuel Grain 4 Port ~ 40” Long
  - Fuel Ports are Circular
- Designed, Fabricated and Tested by General Kinetics Internal Funding
- Design Scaled from 50 lbf Class Hybrid Data of Same Propellants

# Test Schematic

## Legend

	2-way sol. vlv
	position sensor
	press. gauge
	thermocouple
	cavitating venturi/orifice
	turbine flow meter
	3-way sol. vlv
	ball vlv
	press. transducer
	burst disc
	2-way manual vlv
	filter
	hose
	manual reg.
	check vlv
	dome loaded reg.



# *Hybrid Chamber Configuration*

- 9 Inch Diam Al Housing Not Shown
- Initial Port Total Mass Flux  $\sim 0.7 \text{ lbm}/(\text{in}^2\text{-s})$
- Fuel Grain Design is for LDPE
- Ignition via Decomposed Hydrogen Peroxide

# *Hybrid Chamber Catalyst Bed*



- 8 Inch Gas Generator
- Silver Plated Screens

# *Test Data - Video*



- Clear Plume
- Set up Stand in Remote Area and Tested in Single Day

# *Test Data – Measured Pc*

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- Sample Rate 10k Hz, Low Pass Filter 2.5k Hz
- Ignition Transient ~ 400 ms Long

# *Test Data – Waterfall Plot*



- Low Amplitude AC Noise
- 3% Zero-to-Peak of Mean 10-15 Hz

# *Test Data - Reduced*

- Action Time ~ 4 sec
- Ave Chamber Pressure 380 psia
- Oxidizer to Fuel Ratio 9.5 – Above Optimum of 8.5
- L-Star 80 Inches
- C-Star Efficiency 98%
- Oxidizer Mass Flow Rate ~ 10.8 lbm/s
- Fuel Flow Rate ~ 1.14 lbm/s
- Lower Fuel Regression Rate and Higher OF Result of using UHMW
- Smooth Fuel Regression Surface
- Test Duration Limited by Aft Paper Phenolic

# *Fuel Regression Comparison*

- Subscale Data is Single Port Device using 85% H<sub>2</sub>O<sub>2</sub>
- No Direct Sub-Scale Data at Similar Pc and Polymer Type (UHMW)
- Data Suggests Use of LDPE Would Produce Operation at Optimum OF
- Appears Data in Scaleable and Multi-Port Has Minor Influence

7/13/00

# *Conclusions*

- Successfully Design, Fabricated and Tested 2500 lbf Hybrid Engine
- High Combustion Efficiency Was Achieved (98%)
- Appears that Performance Scalable from 50 lbf Sub-Scale Data
- Smooth Operation ~ 3% Zero-to-Peak Oscillations (10-15 Hz)
- Higher Than Optimum OF (9.5) Operation Due to use of UHMWPE