Development and Test of a Rocket Engine Using Environmentally Friendly Propellants

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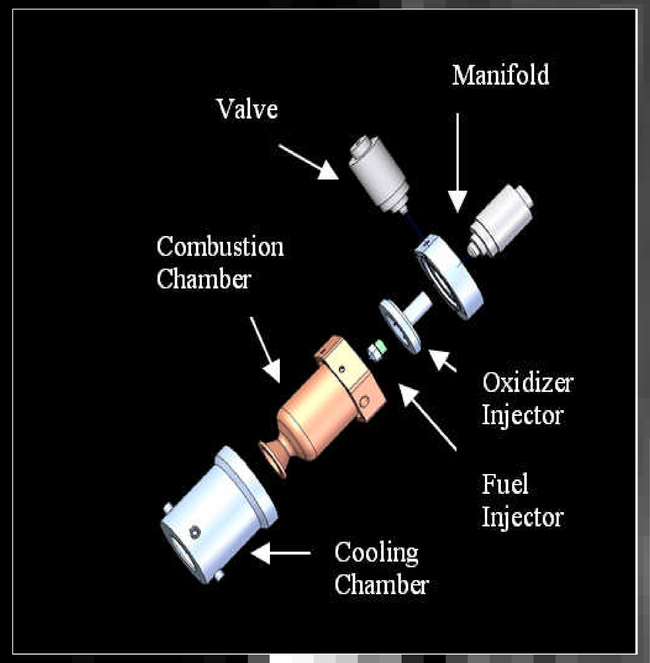
Abstract:

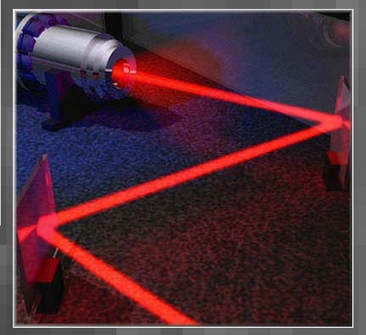
Objective: Develop and test a rocket engine that operates on environmentally friendly propellants; Liquid Oxygen (LOX) and Liquid Methane (LCH4). Due to modifications the rocket engine designed last summer (KJ_REX) is not the same rocket thruster tested this summer, but very similar. The new modified rocket thruster was built for NASA by Orion Propulsion Inc. (OPI), Huntsville, AL.



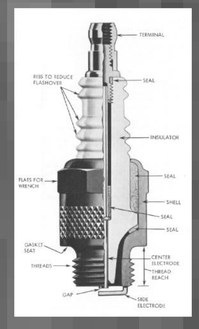
KJ-REX Expanded View

Design:

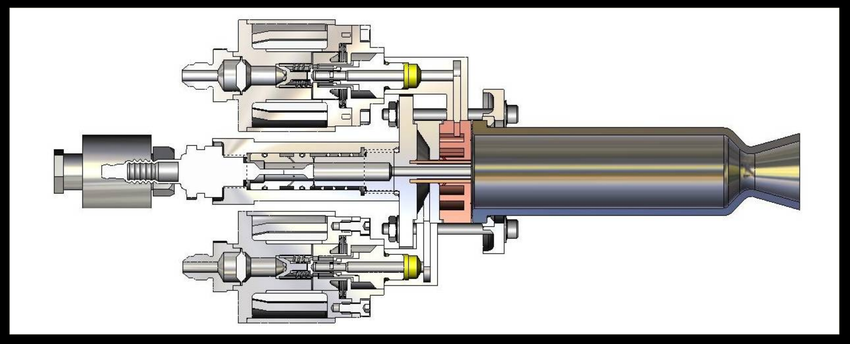
- Manifold: designed to route the fuel (methane) and the oxidizer (GOX) into their respective injectors.
- Injectors: designed so the fuel and the oxidizer impinge in the combustion chamber while the igniter lights the main combustion chamber.
- Source of Ignition: chosen because laser provides a more centered and precise spark. An alternative igniter, a spark plug, can be substituted in the same mounting feature.



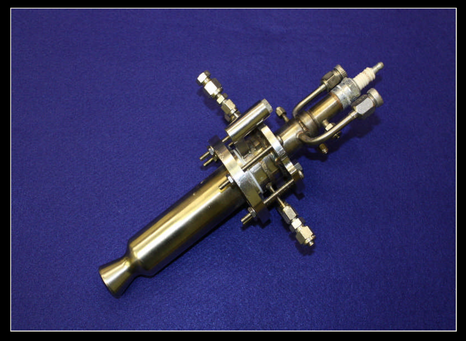
Laser Igniter



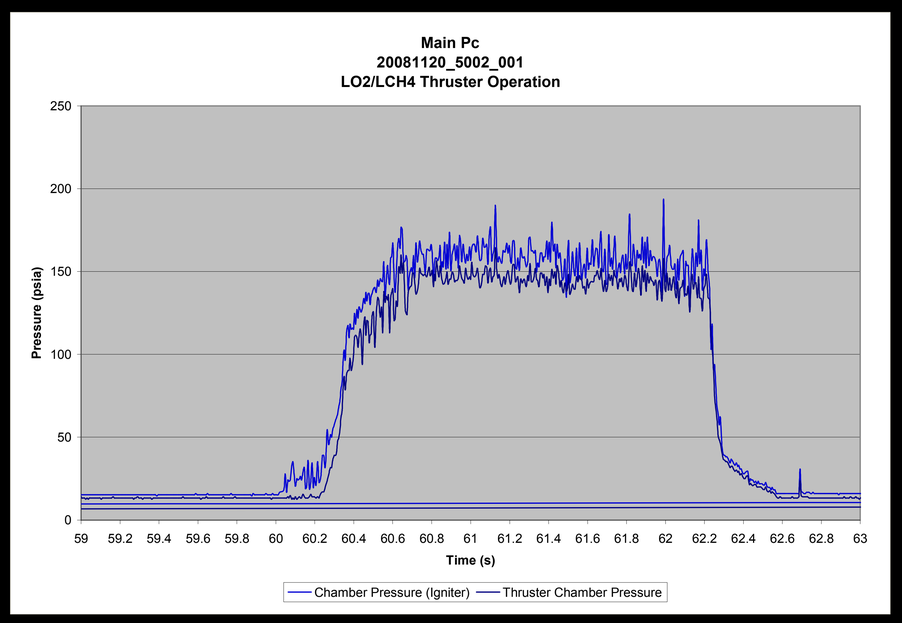
Spark Plug



Orion 100 Pound Developmental Thruster

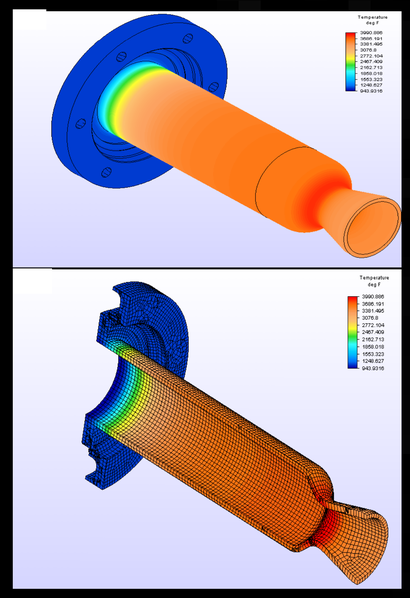


Testing:

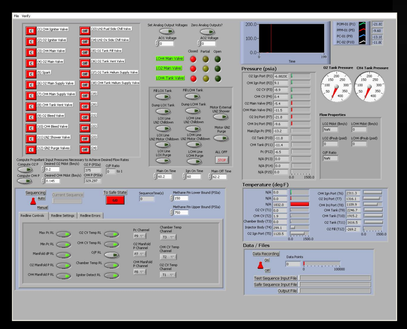


Chamber Pressure Data

Night Time Hot-fire Test



Thermal Model



DAQ System Control Panel

Calculations:

Fuel Flow Rate(wf)	0.1776	lb/sec
Oxidizer Flow Rate(wo)	0.2131	lb/sec
Throat Temperature(Tt)	5163.12	R
Throat Pressure(Pt)	112.8	psia
Throat Area {At}	0.3227	in^2
Throat Diameter {Dt}	0.6412	in
Diameter of the Exit Plane {De}	1.0679	in
Area of Chamber {Ac}	3.9761	in^2
Volume of Chamber {Vc}	17.4947	in^3
L* (Ratio of Chamber Volume: Throat Area)	54.2079	in
Chamber Surface Area	31.4159	in^2
Area of Nozzle Cone	3.1416	in^2
Heat Transfer Area {A}	34.5575	in^2
Total Heat Transferred {Q}	103.6726	Btu/sec
Water Flow Rate {ww}	0.7975	lb/sec
Outer Diameter of Chamber {D1}	2.5000	in
Inner Diameter of Outer Jacket {D2}	2.6256	in
Water Flow Gap	0.0628	in
Fuel Flow Area{A}	0.0654	in^2
Diameter of individual fuel holes	0.0340	in
Oxygen Flow Area {A}	0.0682	in^2
Diameter of individual oxygen holes	0.1060	in
Isp	245	