

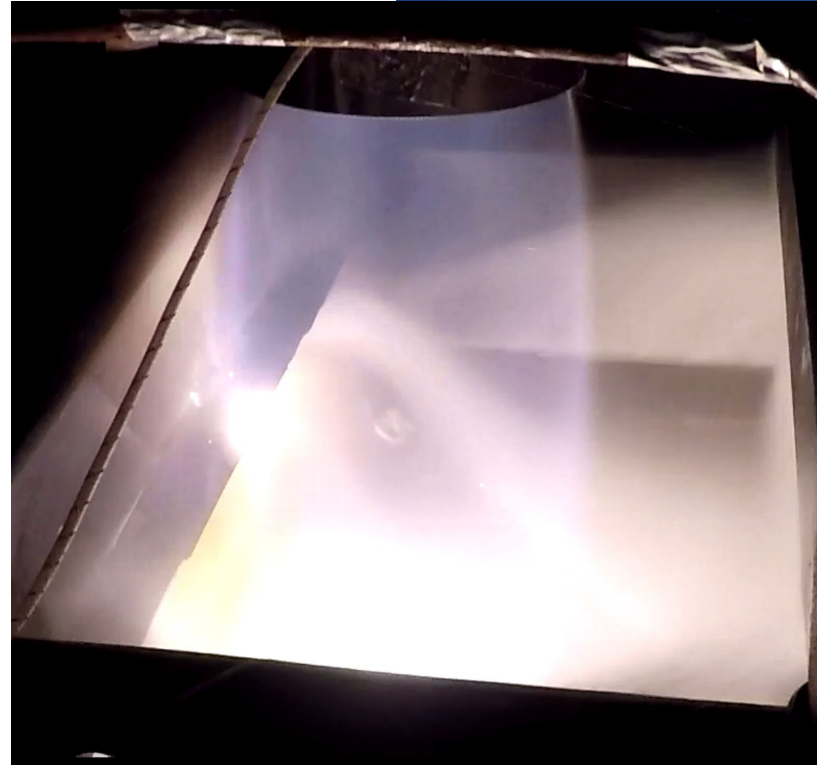


Team 37

Tracking Nitrous Oxide Level with Differential Pressure

Outline

- ▶ Summary and Background
- ▶ Engine Overview
- ▶ Differential Pressure Hardware
- ▶ Nitrous Oxide Fill Process Data
- ▶ Results and Conclusions



Summary

- ▶ Bipropellant liquid rocket engine using Nitrous Oxide and Ethanol
- ▶ Remote oxidizer loading
- ▶ Live tracking of liquid level during fill process
- ▶ Differential pressure transducer integrated with rocket

Importance of Liquid Level Tracking

- ▶ Desire to fill oxidizer tank with accuracy
- ▶ Importance in amateur rocketry:
 - ▶ Many teams launching liquid and hybrid rockets using Nitrous Oxide
 - ▶ Time constraints while rocket is on the rail
- ▶ Could be used to determine oxidizer flow rate

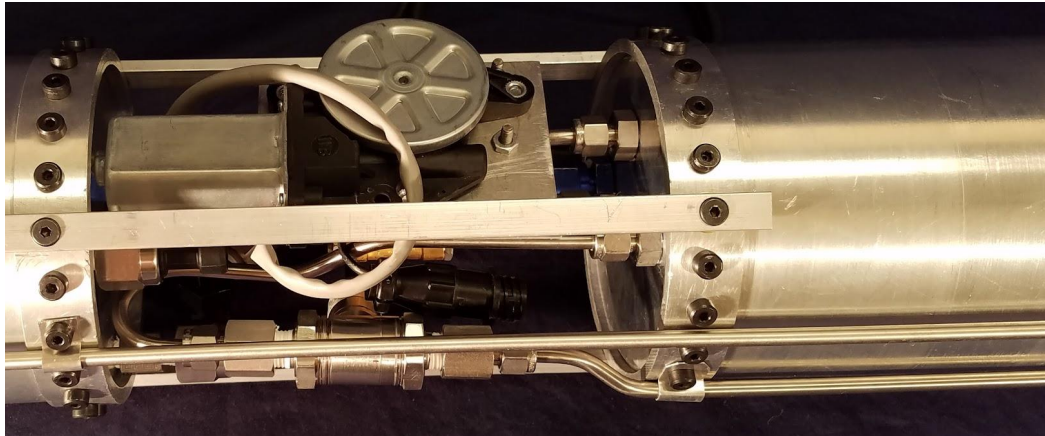
Engine Overview

- ▶ Nitrous Oxide and Ethanol tanks with ablative chamber
- ▶ 11 kN*s total impulse
- ▶ 215 s Isp
- ▶ Compact plumbing and instrumentation
- ▶ Integrated differential pressure transducer



Differential Pressure Hardware

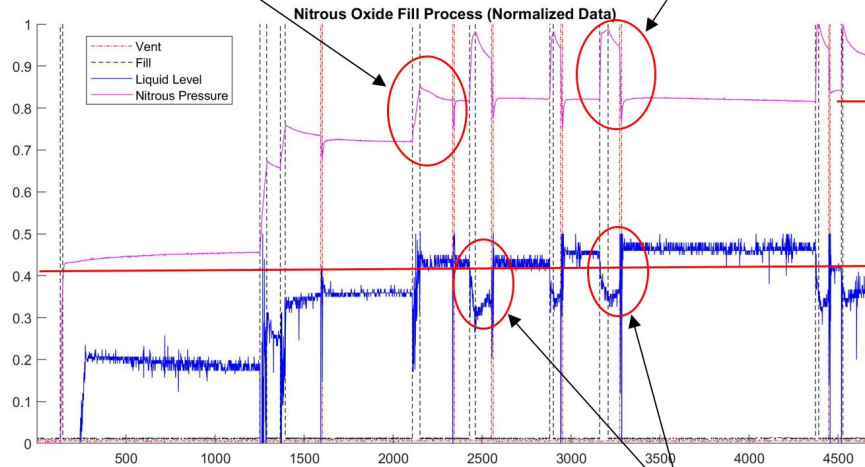
- ▶ 15 psi range differential pressure transducer
- ▶ Stainless steel tubing to top and bottom of Nitrous tank
- ▶ JIC and compression-nut fittings



Nitrous Fill Process Data

Before the tank is full, the nitrous pressure rises gradually when the fill solenoid is opened, but does not drop to the original level when the vent solenoid is opened. This means that before the fill solenoid was opened, the tank wasn't full.

When the tank is full, the nitrous pressure will spike when the fill solenoid is opened, and then drop to the original level when the vent solenoid is opened. This is the vapor pressure of nitrous at the liquid's current temperature.



This line represents the vapor pressure of nitrous oxide. If the tank is full, and the fill solenoid is opened, the pressure will return to this line once the tank is vented.

Based on the features of the liquid level and nitrous pressure plots, it can be inferred that this line represents the "full" level of the nitrous tank.

When tank is full and the fill solenoid is opened, the liquid level readout suddenly drops. It quickly recovers to the same level after the vent is opened.

Conclusion

- ▶ DP transducer exhibits odd behavior when tank is full
- ▶ Can be used reliably for liquid level tracking
- ▶ Excessive noise prevents flow rate data from being collected
- ▶ Further testing and calibration required