Center Wing Fuel Tank Flammability Control

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Flammability Control

Outline

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- Test Article
- Testing Performed
- Results
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Flammability Control

Background

- Recent FAA rulemaking and regulation has focused on improving the safety of the fleet through more thorough systems analysis and ignition source reduction
  - FAA proposes to make a rule requiring flammability control of some or all CWTs with an emphasis on inerting system technologies
- The tool used to evaluate fleet flammability reduction can be used to show that an inerting system is not needed to reduce flammability
  - Other methods suggested in the past are increased flash point requirements, pressurized ullage, and ultra low fuel scavenge
- It remains to be seen how well these methods would be at reducing fleet wide flammability

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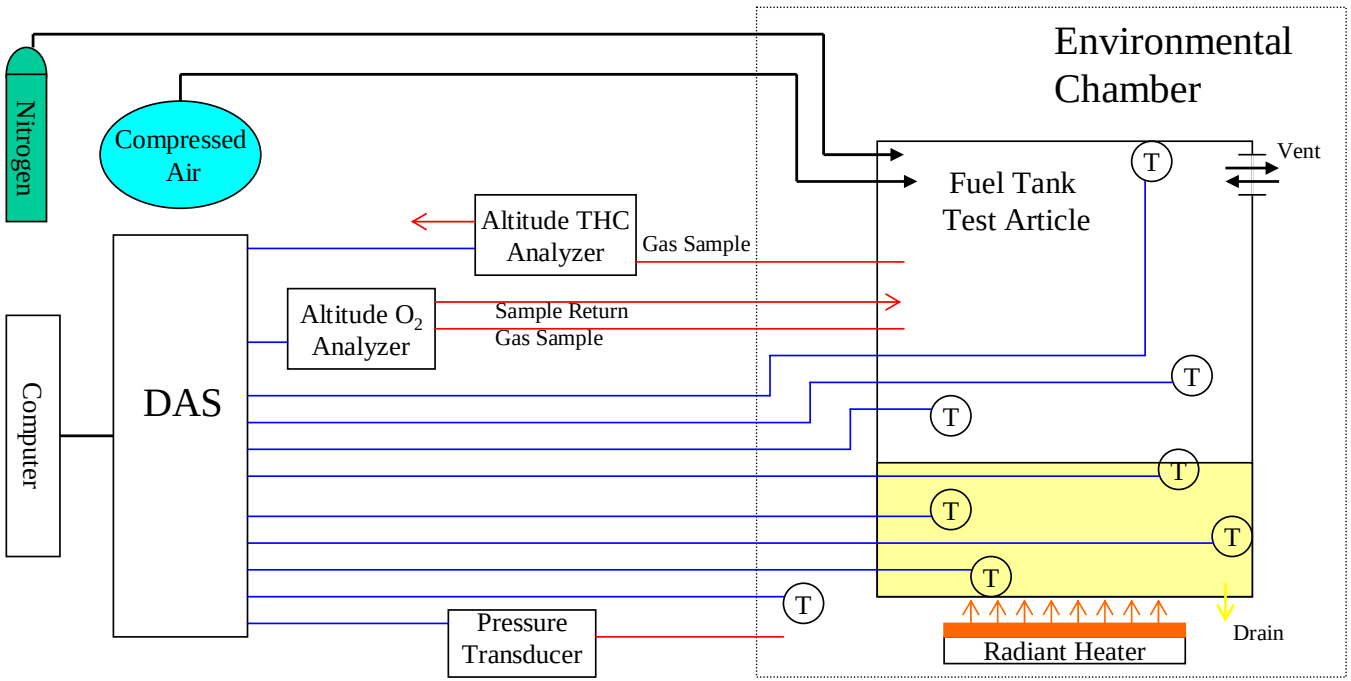
Test Article

- Use the 17^3 tank in environmental chamber as scale CWT
  - Could add fuel, inert ullage, and heat bottom of the tank
  - Instrumentation allowed for surface, fuel, and ullage temperatures as oxygen concentration and discrete THC measurements



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Testing Performed

- Performed base line flammability testing of a “scavenge level” fuel load with a typical CWT type flight cycle
  - Repeated flight cycle for a sumped tank twice, then ventilated the tank and repeated, and last cleaned tank and repeated
  - Fuel had a below average flashpoint (~ 116 deg F)
- Repeated the baseline flammability test for an average flashpoint fuel (~ 123 deg F)
- Compared the average flashpoint baseline with data acquired from two different test articles simulated a CWT flight cycle with a 3 psid ullage
  - Used 5 Gal Oil can test article to get sea level pressure points and 17^3 tank to get flight cycle points

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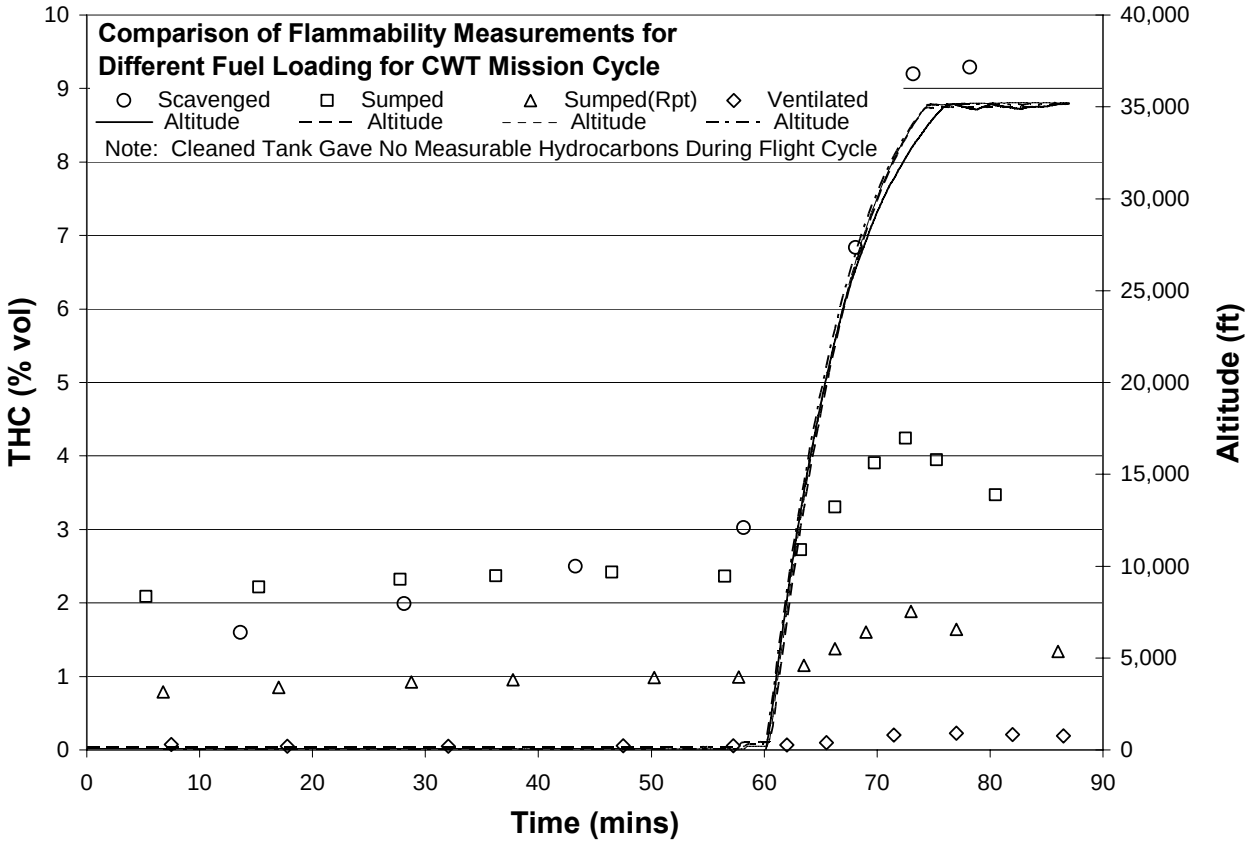
Results - Preliminary

- Reducing the liquid fuel volume in the tank can have a detrimental effect on flammability exposure in the short term
  - Unclear how this relates to an ultra low scavenge system
  - Could not repeat data illustrating the need for additional testing



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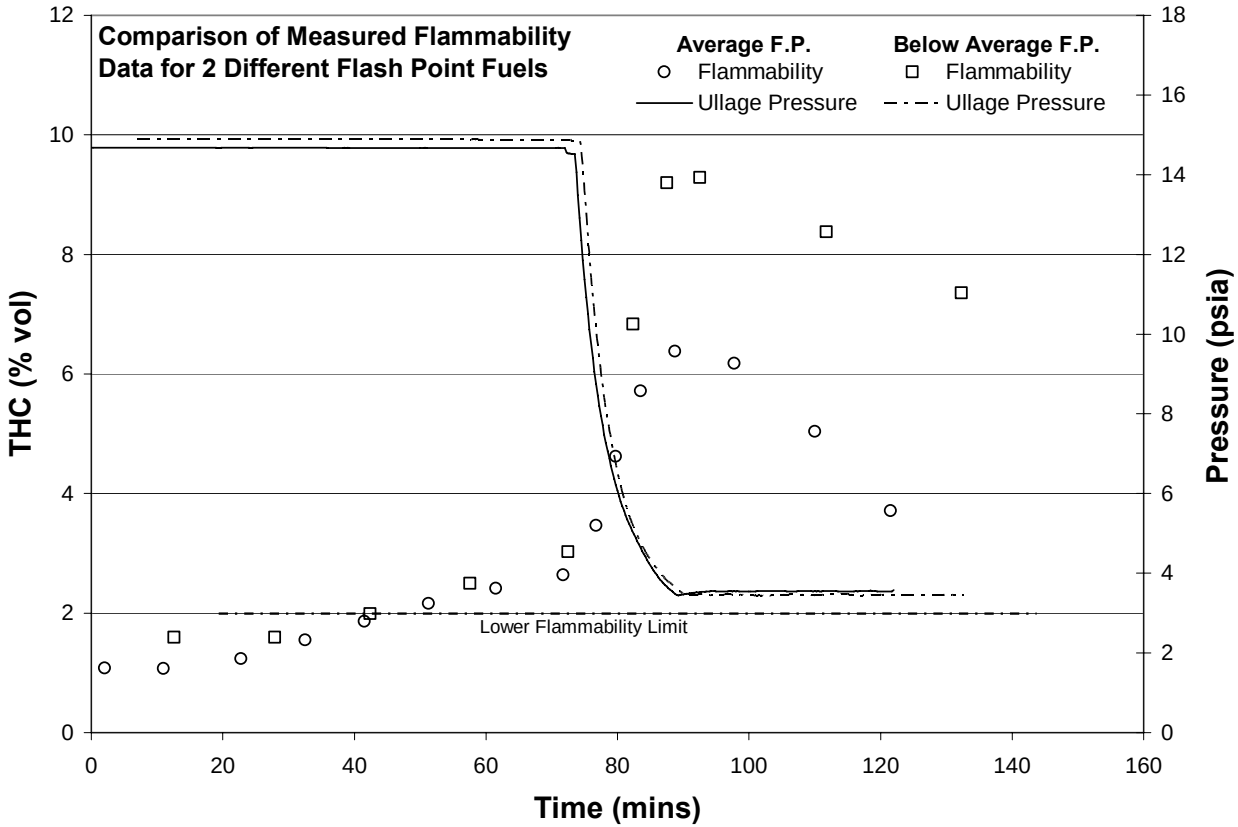
Results - Preliminary

- The fuel flashpoint has a profound effect on the resulting flammability exposure of any given flight cycle for all fuel tank types
  - Limited amount of validation data for our FAR calculations
  - More data of varying F.P. needed for better under-standing



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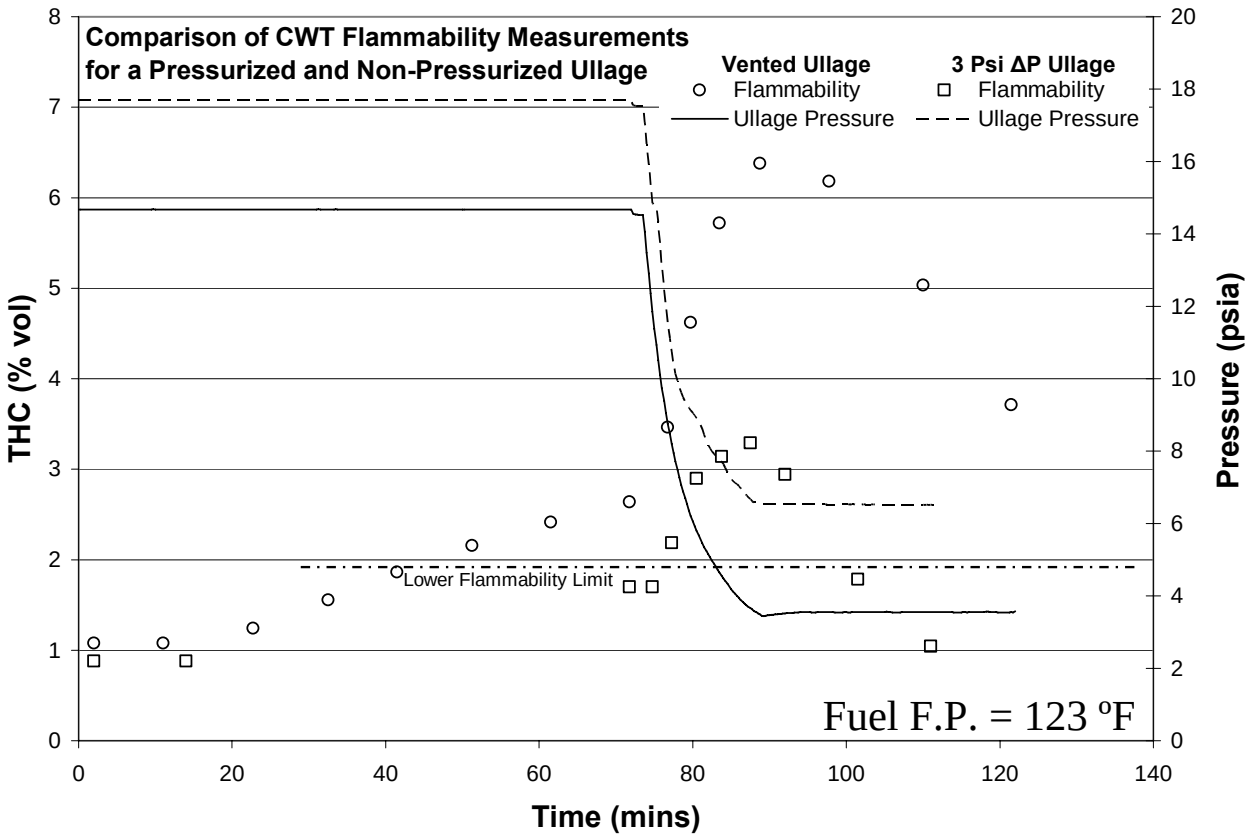
Results - Preliminary

- Increasing the ullage pressure by 3 psi drastically reduced the ullage flammability for a typical CWT mission flight cycle
  - Decreased the exposure time to 23 minutes from 90
  - Tank needs to be under pressure during whole ground time to realize this decrease for more critical cases



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Summary

- We are only beginning to be able to quantify total hydrocarbon content giving the variability of several primary factors effecting fuel tank flammability
  - Limited amount of validation data available
  - Many factors effect the growth and sustainability of a flammable ullage and do not relate in intuitive ways
- Additional work needed in all of these research areas to be able to further increase our understanding of ullage flammability and to increase our ability to predict fuel tank THC with a high degree of accuracy under a wide variety of conditions