COE CST Third Annual Technical Meeting:

Task 299: Nitrous Oxide Composite Case Testing

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Overview

- Team Members
- Purpose of Task
- Research Methodology
- Results or Schedule & Milestones
- Next Steps
- Contact Information

Team Members

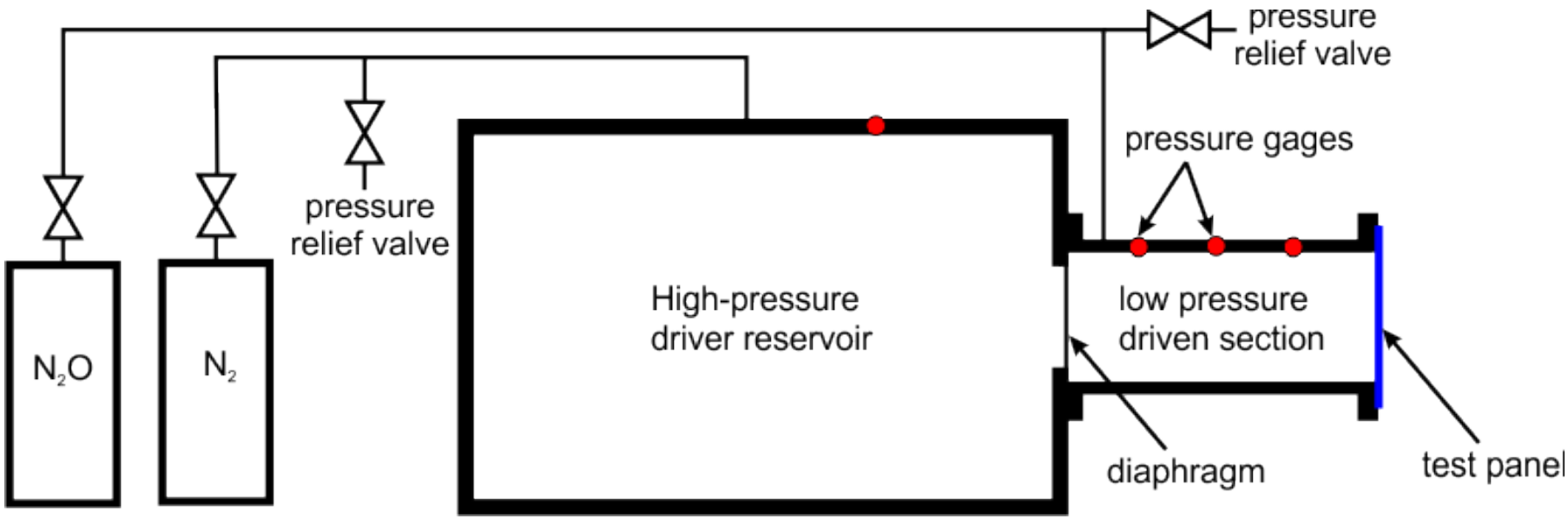
- PI: Warren Ostergren, Associate Professor of Mechanical Engineering, NMT
- Co-PIs:
  - Michael Hargather, Assistant Professor
  - Robert Abernathy, Computational Analyst, Energetic Materials Research and Testing Center (EMRTC)
  - Andrei Zagrai, Associate Professor
- Test Engineer
  - Paul Giannuzzi, Research Engineer, EMRTC
- Students:
  - Jesse Tobin – MS in Mechanical Engineering
  - Steven Bayley – BS in Mechanical Engineering

Purpose of Task

- Develop an understanding of fragmentation hazards from composite tanks used for fuel/oxidizer storage
- Objectives:
  - Test composite panels to understand fragmentation hazards
  - Develop methods to predict fragmentation conditions
  - Develop standard test procedures for composite materials under shock and high-rate loading
  - Develop analytical and computational models to compare to experiments
- Goals
  - Provide data to help set guidelines for safe distances during launch of commercial vehicles
  - Establish standard test procedures for high-rate loading of composites

Research Methodology

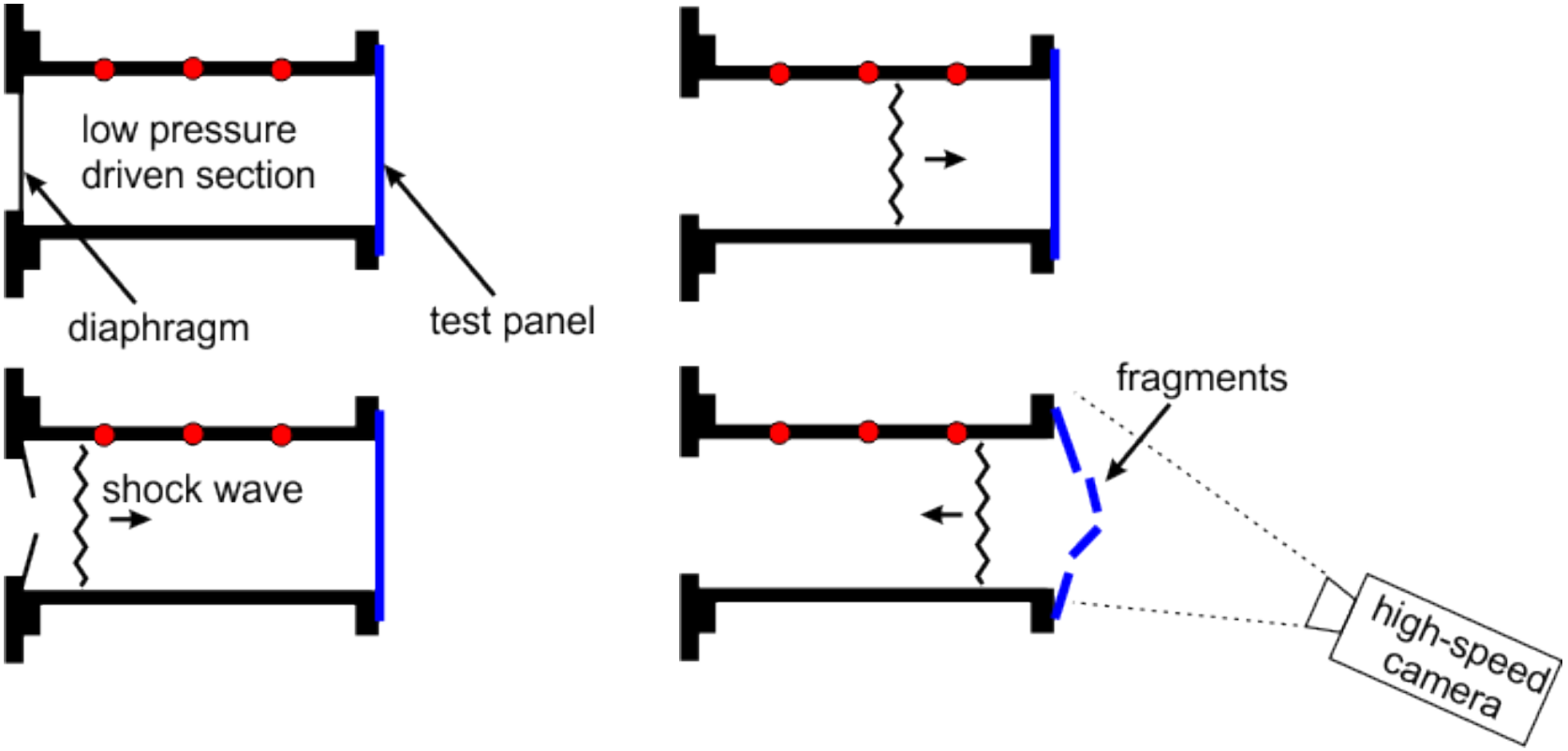
- Test flat panels of composite materials under dynamic, shock loading produced with a diaphragm rupture



- Benchmark facility with aluminum plates
  - Aluminum is used in lined composite tanks
  - Modeling of aluminum can be performed simply

Research Methodology

- High-pressure reservoir pressure = 3000 psi
- Low-pressure section represents the fuel tank, P = 750 psi
- Composite test panel on end of driven section will be fractured



Research Methodology

- Tests will be performed at EMRTC on the NMT campus
  - Initial tests with aluminum panels as benchmark
  - Follow on tests with composite panels
- Data recorded:
  - Pressure measurements in low-pressure section to measure shock loading and dynamic pressure
  - High-speed video showing fragmentation of test panels
  - Acoustic emission measurements on the test panel surface
  - All data synchronized to allow analysis of dynamic failure
- Computational simulations will be performed in CTH
  - Pressure-time history on test panels
  - Estimation of fragmentation/deformation regimes

Results or Schedule/Milestones

- Test fixture currently under construction
  - High-pressure section ready
  - Low-pressure section in final machining stages
  - Pressure gages and all instrumentation have been obtained
- Instrumentation being tested in laboratory
- Composite material selection
  - Obtained samples of composite N_2O tank materials
  - Selection of representative material in progress

Results or Schedule/Milestones

- Testing expected to begin in December
  - Initial aluminum panel tests expected to be complete by mid-January
  - Initial four tests of composite material to be complete by end of March
- Initial computer simulations have begun
  - Computational model of entire system
  - Accurate model for aluminum

Next Steps

- Testing to be performed starting in December
- Computational model of aluminum tests complete before testing commences
- Long term:
  - Selection of a variety of composite materials to represent wide range of variables
  - Incorporation of data from composite tests into computational model
  - Test of full composite N_2O tank
- Establish safety standards for dynamic loading of composite tanks

Contact Information

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