

Sealing Ring Testing and Characterization

Midterm 1



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Sponsored by: Cummins, Inc.
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Outline



- Motivation and Objectives
- Achievements
- Scheduling
- Future Work
- Summary

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Introduction

- Sponsor: Cummins, Inc.:
 - Fuel and power generation systems
 - Fortune 500 company
 - Founded in 1919
- Sealing elements
 - Mating engine components
 - Resistant to harsh conditions
 - Various size and shapes
 - Wide variety of applications

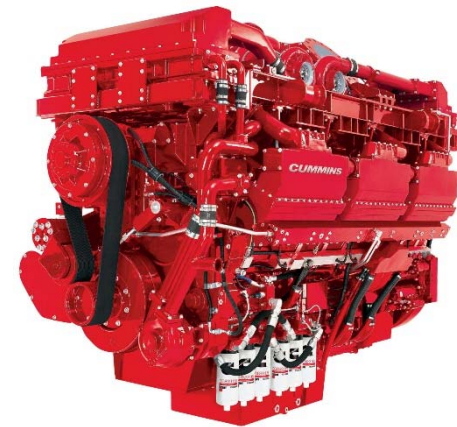


Fig 1: Cummins Engine

Motivation

- Current sealing ring selection process:
 - Finite Element Analysis
 - Time Consuming
 - Costly
- We aim to *reduce time and effort* needed to analyze and design sealing rings using FEA iterations given a specific application

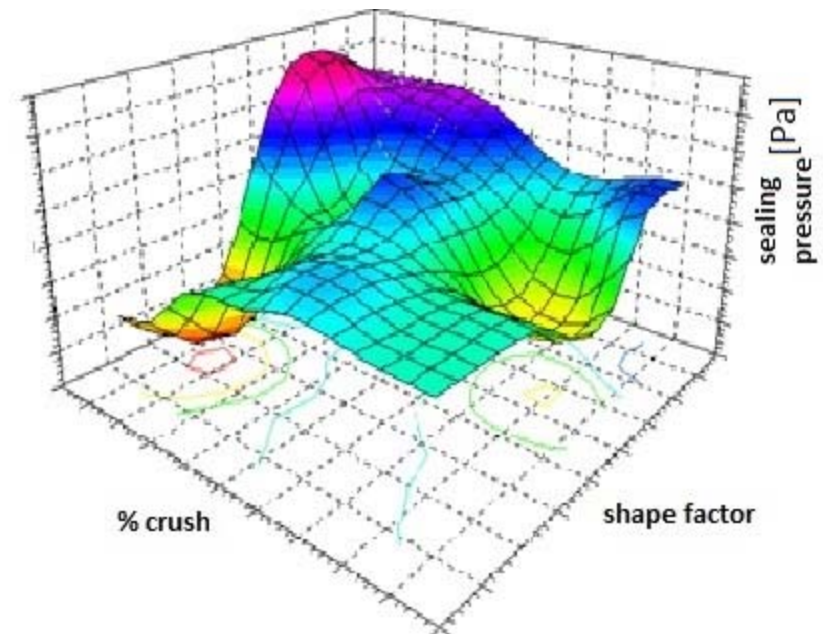


Fig 2: Typical O-rings of various diameter

Objectives



- Test rings in static face-seal compression
- Find relationships between sealing ring properties
 - Physical geometry
 - Sealing pressure
 - Percent crush
- Use relationships to create user interface
 - For example, Figure 3 to the right



s4
s5

Fig 3: End Product Example



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- s4** Make sure you clarify, that it is a picture to show what a contour plot is, and that it is not based on any data or trend that we have seen
studentpro, 2/15/2015
- s5** Or just have another picture
studentpro, 2/15/2015

Requirements



- Test sealing rings of selected cross sections
- Compare test data to find property relations
- Construct end product for simplicity



Completed Work

- Acquired raw materials and equipment
- Designed and redesigned test fixture
- Constructed groove plates
- Performed data analysis on theoretical information
- Researched user interface options



Current Work



- Adjusting fixture for compatibility with new MTS
- Altering procedure
- Preparing for testing



Scheduling - Gantt Chart

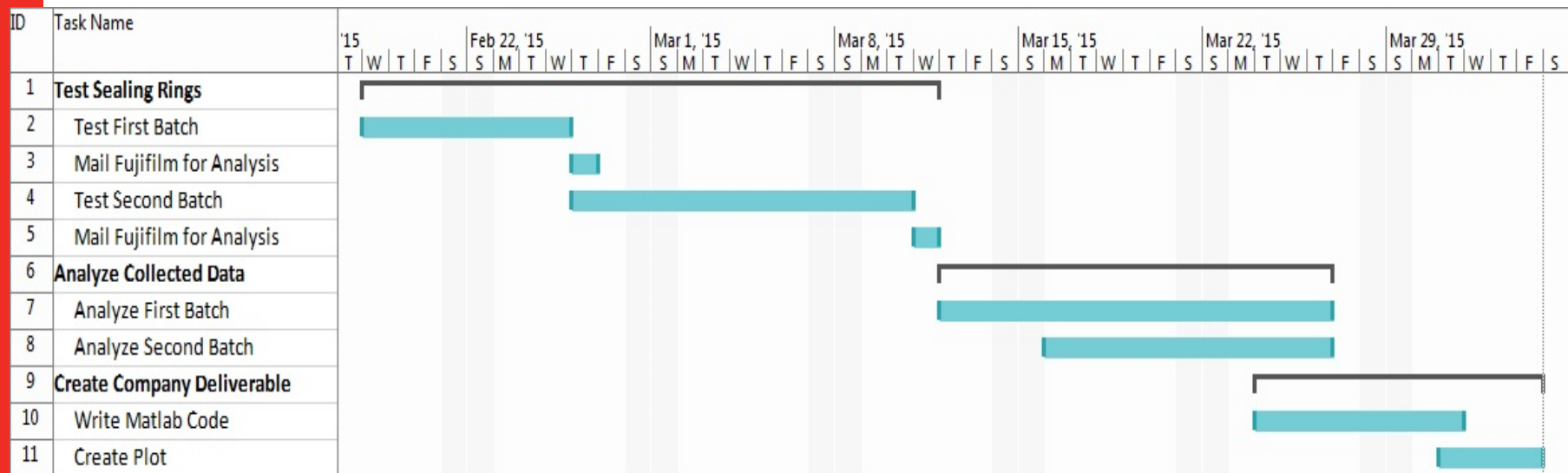


Figure 4: Gantt Chart



Future Work

- Run tests and analyze data
- Define correlation between cross sections
 - Relate percent crush, shape factor, and sealing pressure
- Develop 3-D contour plot
 - Used to find starting point for FEA
- User Interface options
 - MatLab Program
 - Excel spreadsheet
 - User manual



Project Setbacks



- MTS machine at AME no longer available
- New MTS machine requires different test fixture
- Test procedure alterations
- Limited access to new MTS machine



MTS: Old vs. New



Fig 5a: Old MTS

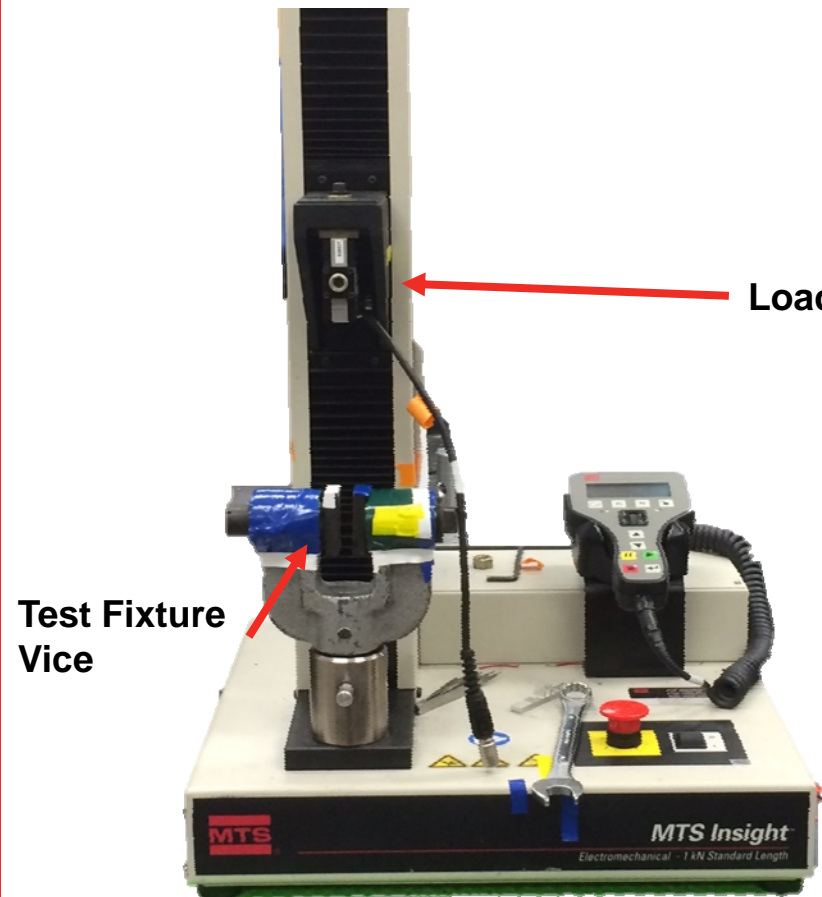
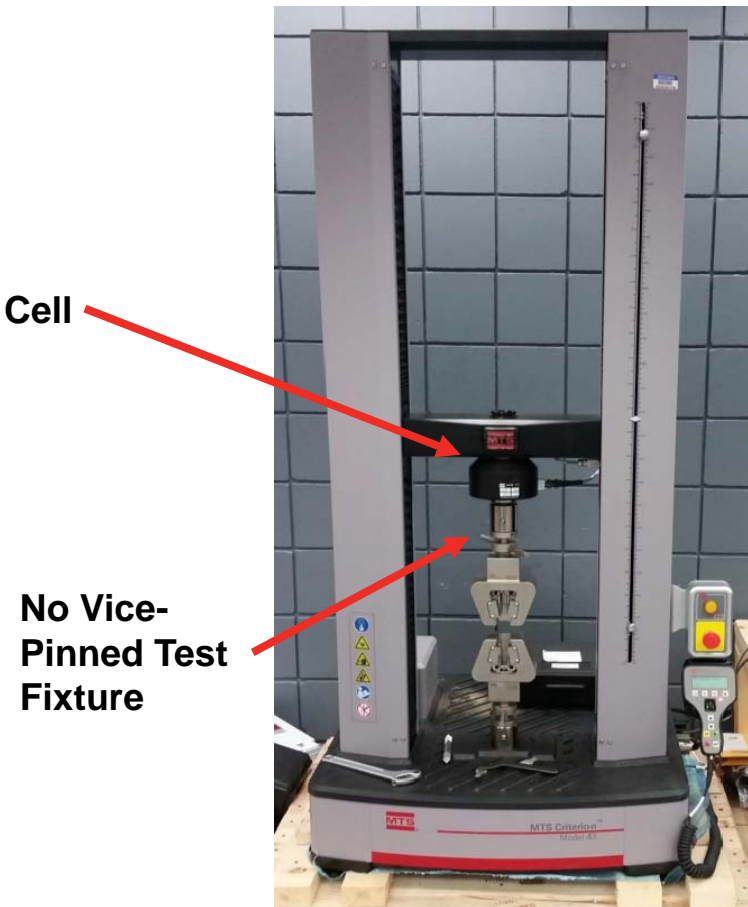


Fig 5b: New MTS



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s8

Mention the differences (load cell, no vice, uses a pin)

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MTS: Old vs. New

Old MTS



Fig 6a: Old Test Fixture Vice



Fig 6b: Pin-Locking Mechanism



Fig 6c: Round Receiver



New MTS

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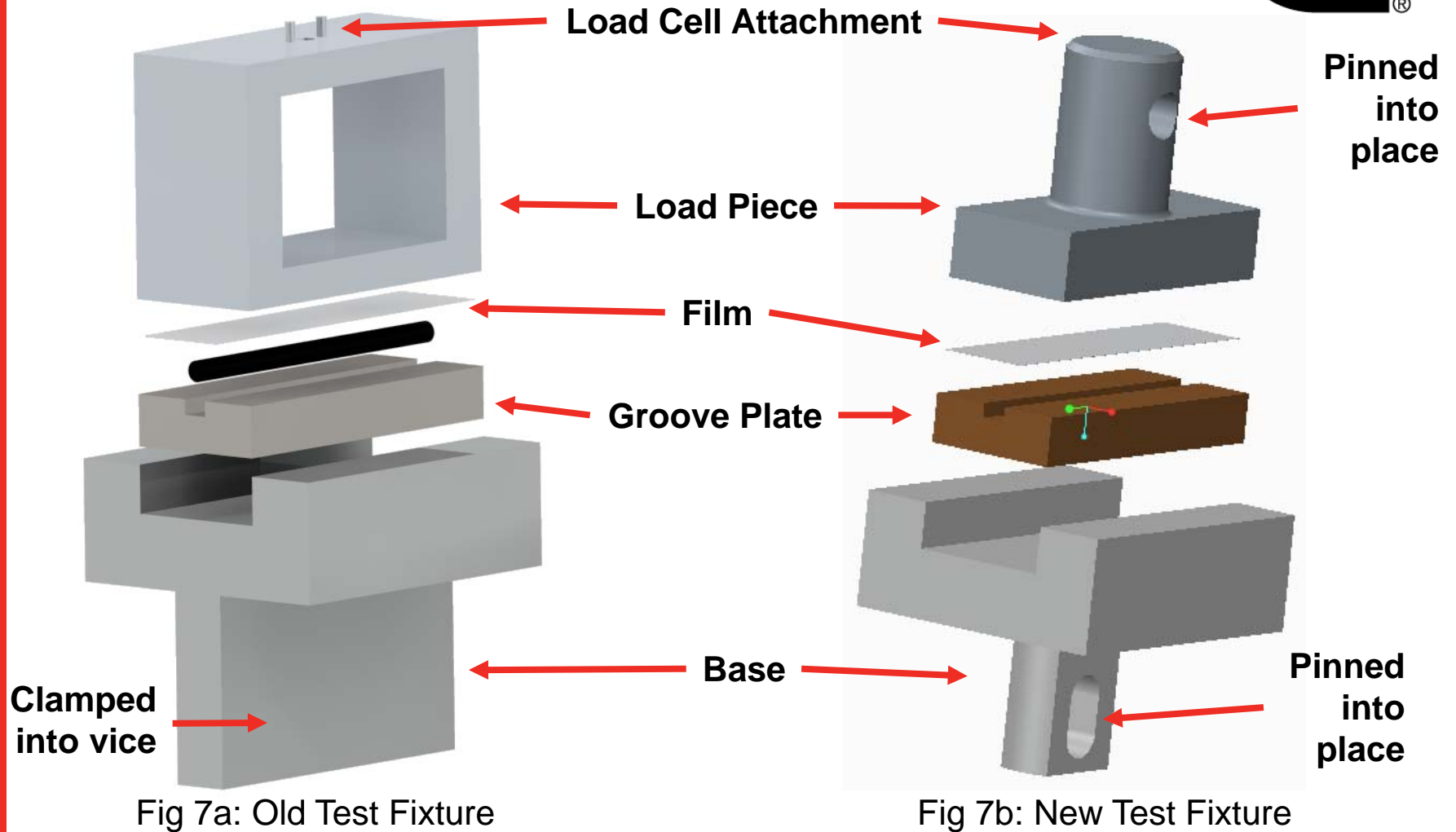
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Mention the differences (load cell, no vice, uses a pin)

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Test Fixture: Old vs. New



Ongoing Challenges



- Organization
 - Handling pressure sensitive film
 - Each sample tested multiple times
- Data Analysis
 - Testing Delays
 - Relate multiple data curves
- Final product
 - Limited Programming knowledge



Summary



- Currently:
 - Test fixture undergoing alterations
 - Creating Excel Macro(s) for data
 - Testing will begin late February/early March

- Challenges:
 - Data Organization
 - Test Consistency
 - Data Analysis
 - Interface Development





QUESTIONS? COMMENTS?



REFERENCES



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2. http://www.nimaxseals.com/dbpics/images/article20100412_KOrings_75.jpg
3. *MTS Machine*. n.d. Webpage. 10 October 2014. <<http://www.testresources.net/200-series-electromechanical-test-machines/210m1125-standalone-test-machines/>>.
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