Sealing Ring Testing and Characterization
Spring Update

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Outline

- Introduction and Goals
- Objectives and Scope
- Testing
- Result Expectations
- Challenges
- Scheduling

Introduction

- Elastomeric sealing rings are:
  - Seal engine components
  - Resistant to high temperature, pressure differences, and corrosive chemicals
  - Not always circular cross sections
    - Certain cross sections perform better in particular applications
    - Reduction in material lowers cost
- Current sealing ring selection process requires multiple iterations of finite element analysis
  - Time Consuming
  - Costly
- GOALS: To improve the sealing ring selection
  - Provide approximate starting point for analysis
  - Reduce the number of FEA iterations
  - Reduce time and effort needed

Objectives

Team 1 will attempt to improve the selection process by:

- Examining sealing rings in static face seal-compression tests
- Searching for correlations between sealing ring properties
  - the physical geometry of the sealing rings
  - the pressure required to make a complete seal
  - the percentage the sealing ring was crushed to achieve seal
- Correlations used to create a user interface
  - Input application parameters
  - Output shape factor corresponding to appropriate cross section geometries

Project Scope

- New process should be applicable to a variety of FKM sealing ring cross sections

- FKM material
  - Common material used by Cummins, Inc. and other manufactures
  - Is very resistant to heat and chemicals compared to other elastomers
  - Versatile for use in wide range of applications

- Cross sections determined by Cummins, Inc.
  - 23 total cross section geometries
  - Widths ranging from 1 to 10 millimeters
  - Size chosen to accommodate max load of 1 kN by MTS machine
  - Measuring crush up to 40% in 5% increments

Delimitations

- General Assumptions
  - Clean environment
  - Ambient temperature and pressure

- Delimitations
  - Small, straight samples
  - Static, face seal vs. dynamic radial seal
  - Zero tension on seal
  - One time use samples - no fatigue
  - Wall effects from grooves ignored for regular samples

Test Method

- Testing Parameters
  - Compression
  - Increments of percent crush
  - Straight sections of seals
- Measurements
  - Load needed to achieve percent crush
  - Sealing pressure given by pressure sensitive film

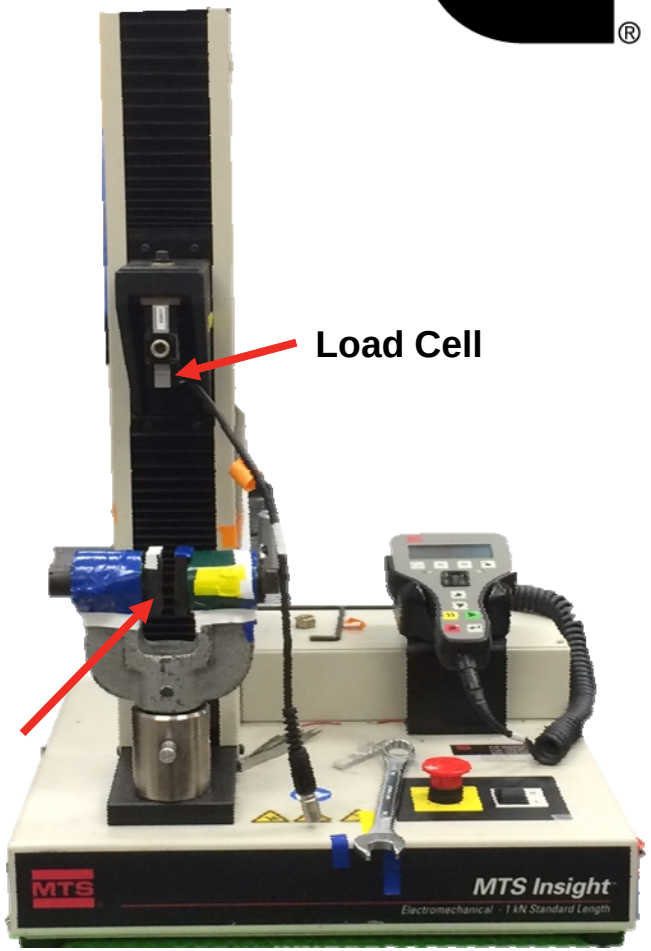

Figure 1: MTS Machine

Test Fixture

- Test fixture features
  - Designed to be used with MTS machine
  - Minimal deflection
  - Groove interchangeability
  - Self leveling
- Aluminum 6061
  - Machinability
  - Stiffness
  - Readily available

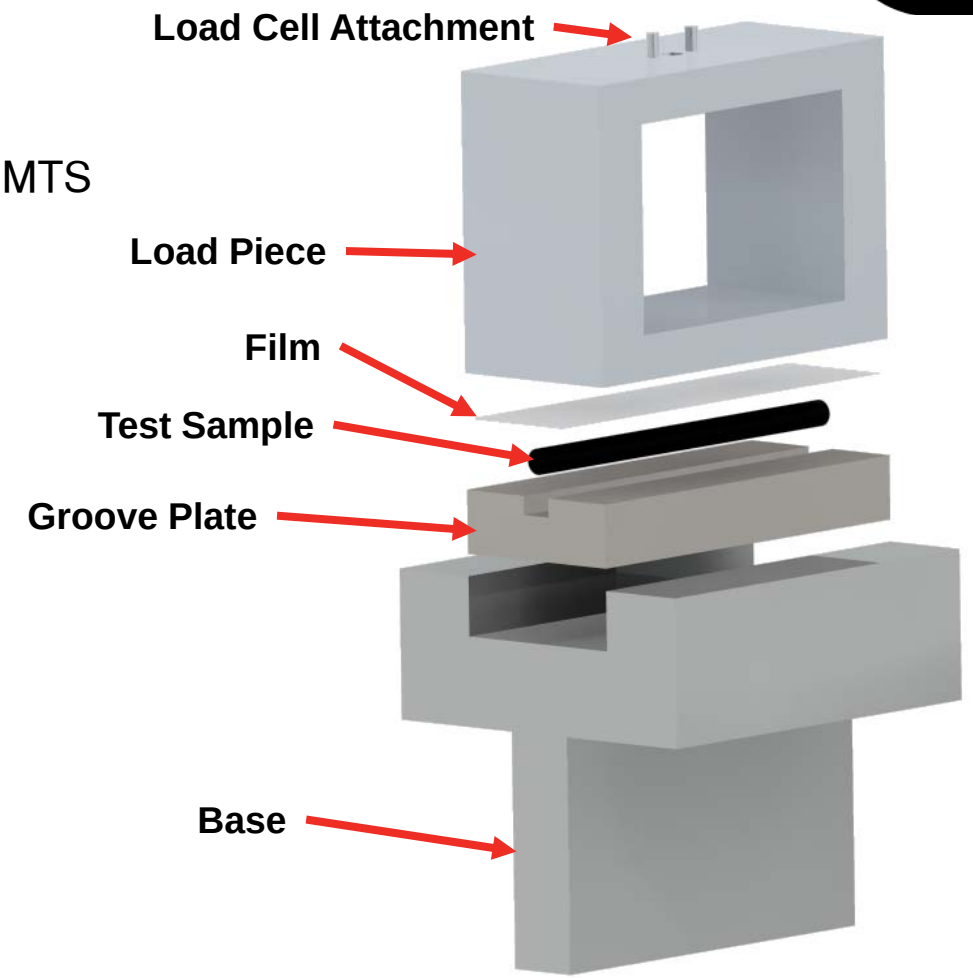

Figure 2: Test Fixture

Preliminary Data Assessment

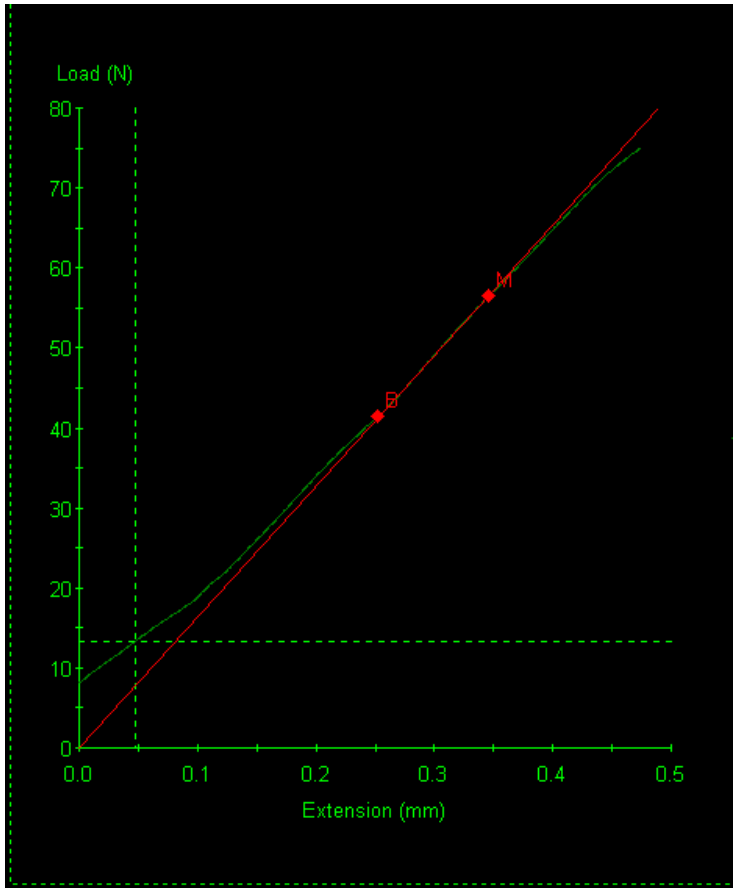

Figure 3: Data output from MTS machine

- Fujifilm Prescale
  - 200 kPa ~10,000 kPa
  - Three sensitivities required
  - Film to be shipped to Cummins scanned and imported into excel to be processed
- Load Cells
  - 5 N, 100 N, and 1 kN
  - Various options for measurement

Test Result Expectations

- 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

Challenges

- Organization
  - Handling lots of pressure sensitive film
    - 5-40%, for 2 trials, for every cross section
- Test Procedure Consistency
  - Ensure reliable and easily reproducible data
- Data Analysis
  - Testing Delay
  - Relate multiple data curves
  - Find Major Factor
- Final product
  - Limited Programming Technique

Scheduling - Work Breakdown

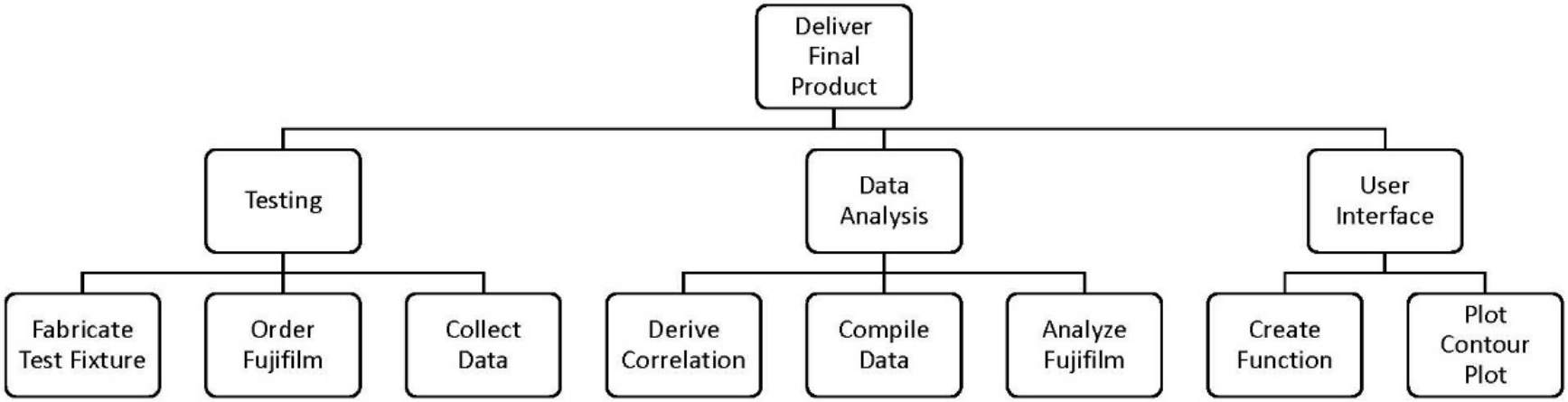

Figure 5: Workflow Breakdown Structure

Scheduling - Gantt Chart

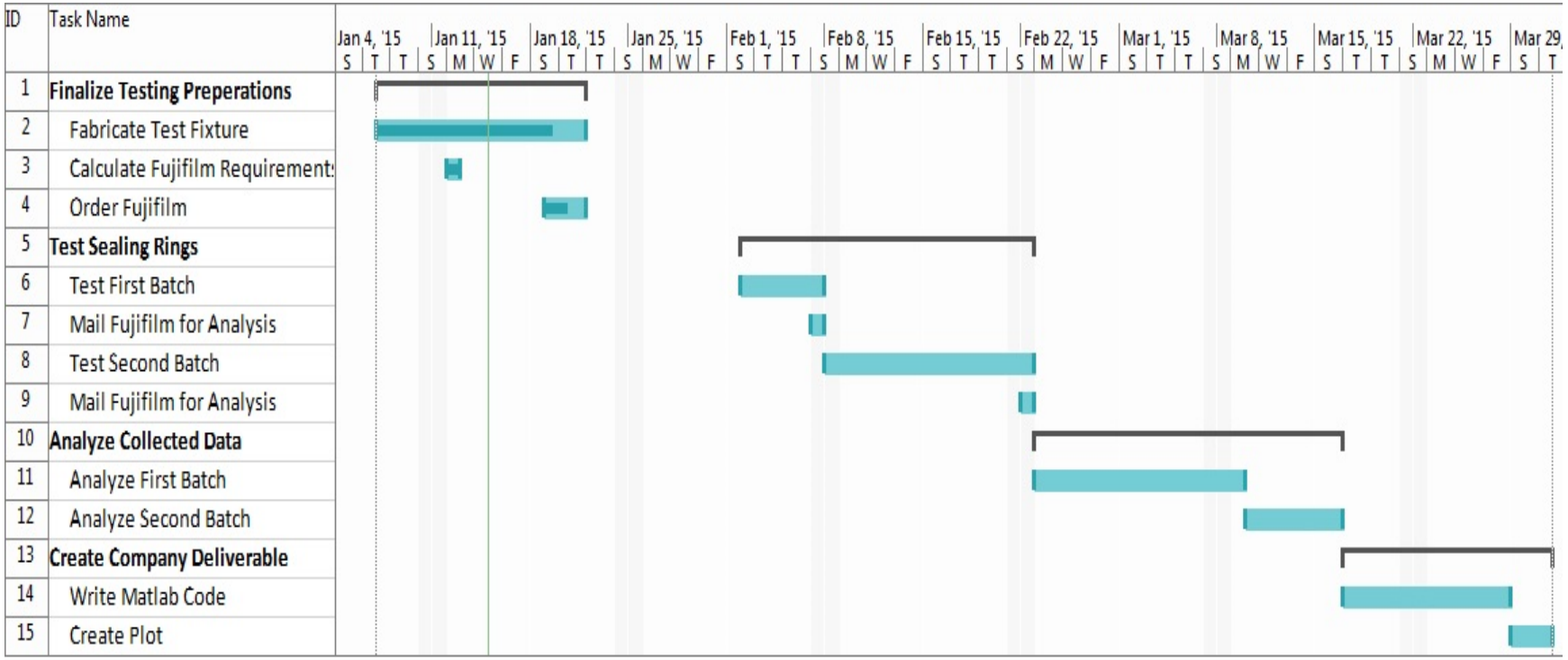

Figure 4: Gantt Chart

Summary

- Currently:
  - Test fixture is in fabrication
  - Fujifilm sensitivities are being calculated
  - Testing will begin in February

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

QUESTIONS? COMMENTS?

REFERENCES

1. *MTS Machine*. n.d. Webpage. 10 October 2014. <http://www.testresources.net/200-series-electromechanical-test-machines/210m1125-standalone-test-machines/>.
2. *3D Contour Plot*. n.d. Webpage. 10 October 2014. <http://www.agocg.ac.uk/reports/graphics/34/appii97/chapte_7.htm>.
3. *Fujifilm Paper*. n.d. Webpage. 10 October 2014. <http://sensorprod.ca/>.