Sealing Ring Testing and Characterization

Team 1

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Purpose

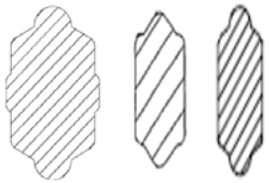
Develop a method that will reduce time and effort needed for irregular sealing ring design by providing an approximate starting point for finite element analysis used during the design process.

Motivation

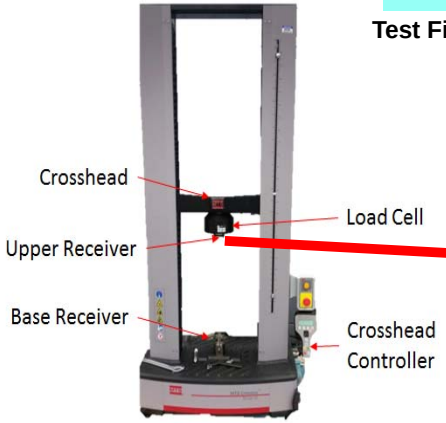
Current test procedures for elastomeric materials utilize standardized test samples and do not give insight into how irregular cross sectional shapes behave under compression.

Objectives

- Define a shape factor that correlates the geometry of a seal ring cross section with the sealing pressure at a given percent crush using MTS machine test fixture below.
- Develop a user interface that receives parameters of an application and outputs an estimation of the performance of particular seal ring shapes.



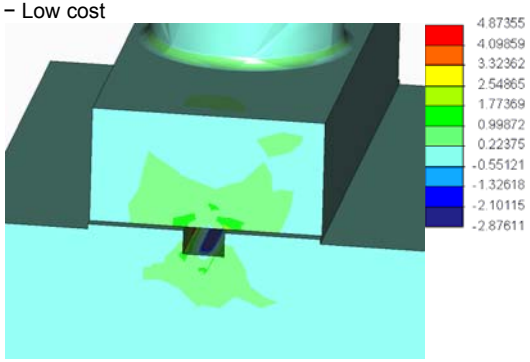
Irregular Seal Shapes: Diamond and Pseudo-Diamond Seals



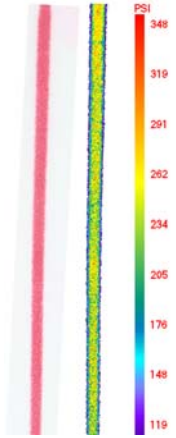
MTS Machine

Test Fixture

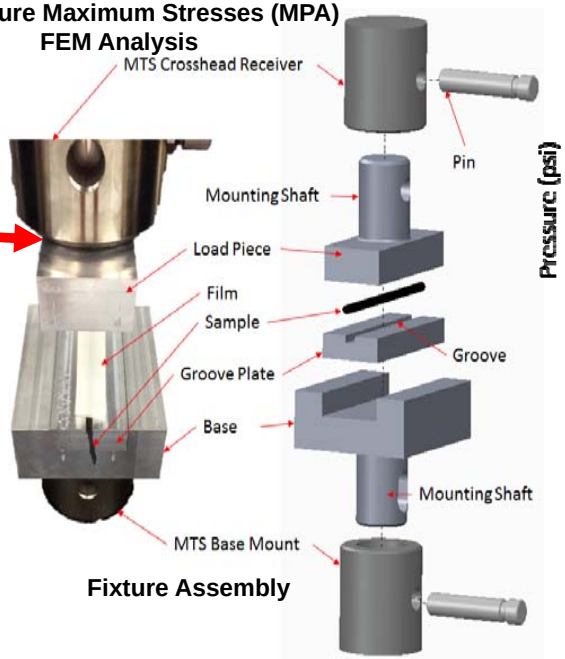
- Designed to be used with existing equipment
- Material: Aluminum 6061-t6511
  - Rigidity
  - Machinability
  - Low cost



Test Fixture Maximum Stresses (MPA) FEM Analysis



Film After Testing and Scanning

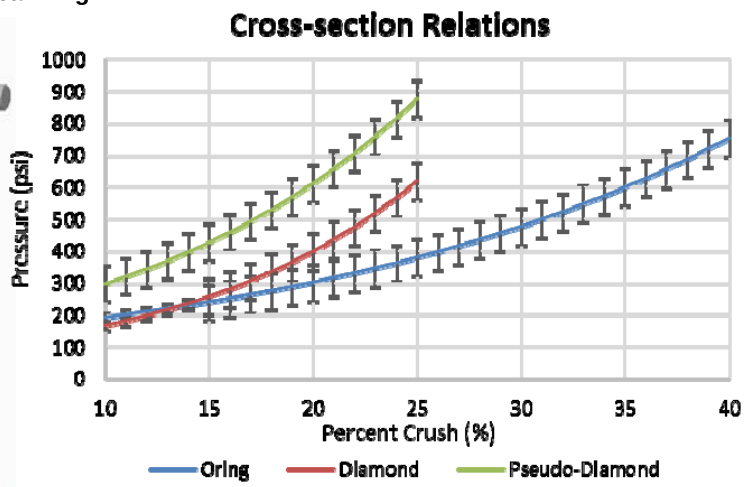


Fixture Assembly

Data Analysis

- Compression tests showed how the deformation of seals under various loads corresponded to sealing pressure using film (right). From this relationship, a correlation was derived and a geometric shape factor can be defined.
- Correlations between sealing pressure and percent crush (C) were derived for Circular, Diamond and Pseudo-Diamond cross sections using equations below

- $P_{Oring} = 120.5 \times e^{(0.0458 \times C)}$
- $P_{Diamond} = 68.623 \times e^{(0.0879 \times C)}$
- $P_{Ps-Diamond} = 145.17 \times e^{(0.0719 \times C)}$



Testing

- Tests performed on MTS machine with custom fixture
  - Uniform compression applied to seal samples by load piece
  - Samples compressed at intervals of percent crush
- Data Outputs
  - Load needed to achieve percent crush
  - Sealing pressure measured with pressure sensitive film

Future Work

- Perform tests and derive correlations for more cross section sizes and geometries.
- Design a fixture that receives grooves that utilize the entire seal and perform analysis
- Further develop user interface