Lycoming Engines – Design of Novel Piston Rings

Overview
Lycoming Engines has built over 325,000 piston aircraft engines – powering over half of the world’s propeller airplanes. The design task was to develop a preliminary design of a piston ring assembly for use in air-cooled aircraft internal combustion engines. Lycoming currently uses two cast iron keystone shaped compression rings and an oil control ring.

Objectives
The main objective is to deliver a novel piston ring design that will improve engine performance while maintaining product life cycle. The main design aspects the team focused on were:
- Improving combustion gas sealing
- Reducing oil consumption
- Reducing wear and friction on the piston, piston ring, and piston cylinder wall
- Exceeding a minimum life cycle of 2000 hours of operation.

Approach
- The team developed customer needs and engineering specifications for the design task.
- The team determined that ring geometry, material, and coating would be changed to improve the design.
- Concepts were generated and a scoring matrix was completed to determine that a barrel face top ring, napier scraper middle ring, and oil control ring is the best design. The ring material is SAE 9254 Steel, and the top ring will be coated with either a diamond-like-carbon (DLC) or Chromium Nitride (CrN).
- The team visited the Lycoming facility three times in order to complete design task and to conduct testing.
- SAE 9254 Steel Coupons were made and sent to Richter Precision and coated with DLC and CrN.
- Multiple samples were tested to determine the wear rate, friction, and adhesion of material.

Outcomes
- The DLC coating provides a much better wear resistance and lower coefficient of friction, improving the performance and life cycle.
- The sponsor will have an improved piston ring assembly for equal cost of the old design.
- Quality control must be integrated to ensure adequate adhesion of the coating.
- The sponsor will manufacture the purposed design and perform engine tests to determine if the use of DLC coated rings will be implemented.