Background

- Advanced LIDAR (Light Detection and Ranging) used for tactical airborne applications sensor requires a large amount of heat removal
- Size constraints require a compact cooling solution
- System integration provides pre-existing liquid coolant of (Polyalphaoelin) PAO
- Previous generations of cooling systems have applied damaging forces to the sensor

Objectives/Requirements

- 23 watts removed from 0.6"x0.6" sensor
- ≤ 15°C must be maintained on the slug interface
- Cooling fluid provided is 15°C
- Must fit in a 2.07"x2.29"x3.68" space constraint
- Design for a factor of safety of 2 for slug torque

Simulation/Analysis

- Fluid Flowrate (gpm) | TEC Power (W) | Slug Temp (°C) | Slug Moment Failure Testing
- PAO 0.18 | 9.4 | 14.83 |
- PAO 0.18 | 62.2 | 4.27 |
- PAO 0.44 | 62.0 | 1.33 |
- Water 2.2 | 57.0 | -5.21 |
- Test 2.2 | 60 | -3.3 |

Thermal Testing and Results

- 0.18 GPM of PAO flow with 9.4W into the TEC
- 21.26°C
- 20.59°C
- 19.90°C
- 19.20°C
- 18.51°C
- 17.82°C
- 17.13°C
- 16.44°C
- 15.75°C
- 15.06°C
- 14.37°C
- 13.68°C
- 13.00°C
- 12.31°C
- 11.62°C
- 10.93°C

- Able to meet cooling requirements with 9.4W electrical input at minimum coolant flowrate
- Temperature difference of 10°C between testing and consumer applications

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Conclusions and Future Work

- The system removes the concern for slug breakage
- Exceeding thermal requirements means a redesign for ease of manufacturing and assembly would be beneficial
- Thermal interface materials such as the graphite sheets had the greatest effect on thermal performance
- Copper has corrosion issues
- Our correlation between PAO and water for our design proves that our design exceeds cooling requirements

Thermoelectric Cooler (TEC)

- TEC devices create a temperature difference, driving heat flow through our system
- This is done by applying a current to a series circuit of 2 dissimilar metals with different base energies