Determining the Effectiveness Of Oleophobic Gaskets

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Purpose

Cummins Inc. has proposed a project to determine the effectiveness of oleophobic gaskets to reduce the measured leak rate at low pressure, large joints on engines compared to the current gaskets used on engines.

Background

- Oleophobic items are items which repel oil by having a lower surface energy than the oil.
- A gasket is an item which is placed between two flanges to form a seal, which is meant to prevent oils from leaking to the opposite side of the flange.
- The theory behind the project is that if the gasket can repel the oil, it is less likely that a leak will occur.
- Common gasket types that are used in this application include paper and rubber coated metal (RCM).
- Modified Ideal Gas Law $P_1V_1=P_2V_2$ used to measure leak.

Objectives

- Research what causes items to become oleophobic.
- Create oleophobic gaskets using on market products.
- Create oleophobic gaskets using non-conventional gasket materials.
- Design and build the test rig to be capable of varying clamping pressure and temperature.
- Test oleophobic gaskets and currently used gaskets for leak rate and compare results.

Preliminary Gasket Testing

Paper Gasket

No Oleophobic Solution

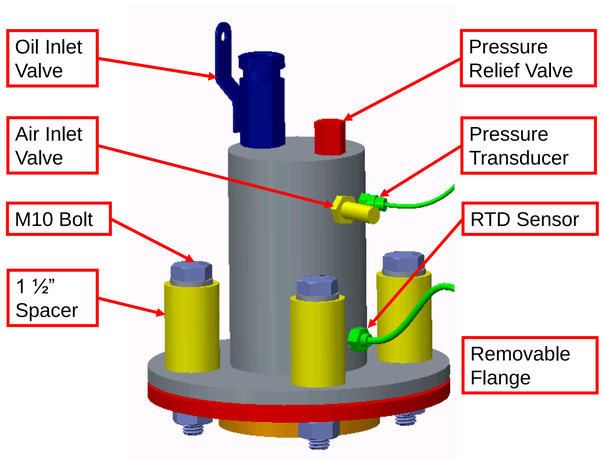
Oleophobic Impregnation Solution

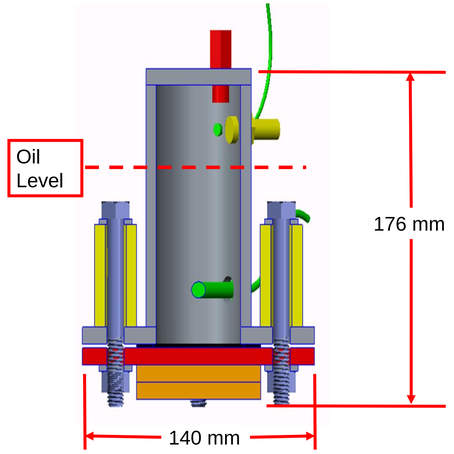
Felt Gasket

No Oleophobic Solution

Spray Oleophobic Solution

Test Rig Conceptual Design

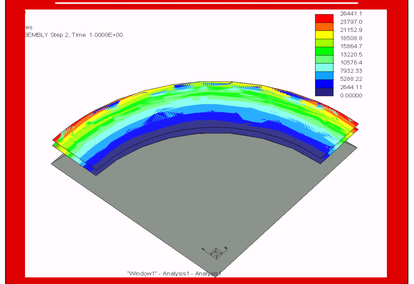




CAD model of the final design for the test rig.

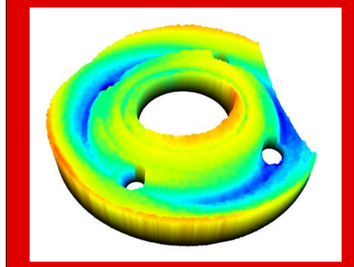
Design Analysis

Gasket Pressure FEA

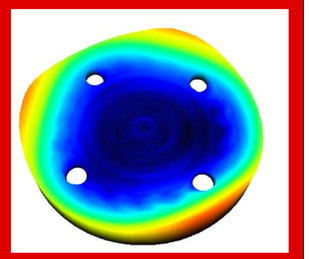


Verified clamping pressure calculations

Flange Surface Roughness Measurement



Top Flange
2.90 microns RA



Bottom Flange
2.03 microns RA

Acknowledgements

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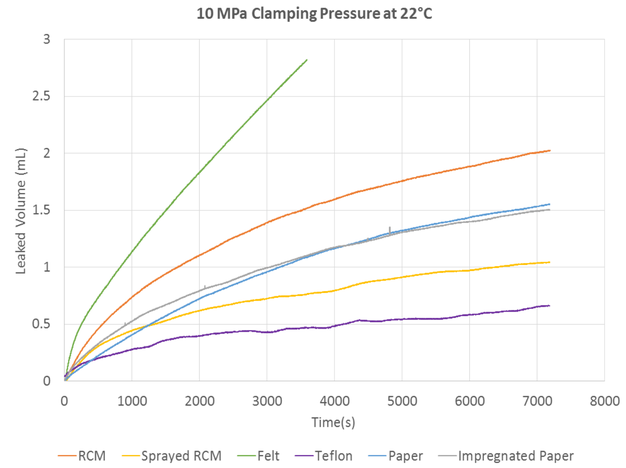
Results



Total Leak Volume over 2 Hours

Material	Temperature (℃)	Leakage (mL)		
		0.5MPa	2MPa	10MPa
Paper	22	2.28	0.48	1.55
	120	7.12	2.03	1.73
Impregnated Paper	22	8.62	1.18	1.50
	120	1.56	1.46	1.74
RCM	22	4.62	3.48	2.02
	120	0.93	2.31	7.81
Sprayed RCM	22	0.50	1.00	1.05
	120	2.16	1.39	2.05
Teflon	22	1.64	1.58	0.66
	120	1.07	1.45	1.22
Felt	22	26.35	25.03	2.83 (1 hr)

Conclusion

- Impregnated gaskets are not effective, however sprayed gaskets may have potential.
- Felt gaskets were determined to be unviable.
- Teflon gaskets performed well, but cost is a major deterrent.

Future Work

- Future work will be required to improve the durability of the sprayed solutions.