Title: Extreme-Pressure Lubricant Evaluation

1 Summary

1.1 Purpose

The purpose of the evaluation was to find a lubricant that could reduce or eliminate damage caused by metal to metal contact in an internal combustion engine.

1.2 Results and Conclusion

The Timken extreme pressure test was performed using 4 different grades of oil viscosity. Eleven different manufacturers of oil across these 4 grades of viscosity were chosen based on available product. In every viscosity grade, TriboDyn Technologies performed the best.

2 Background

Advanced Engine Technologies has developed patented technologies for internal combustion engines. Development was conducted on reciprocating and rotary single cylinder engines. While testing the baseline engines, metal to metal contact was a problem as shown on the piston below.

Therefore, the desire to find an engine oil to reduce or eliminate wear in a standard engine would greatly improve the development work on the patented technologies.

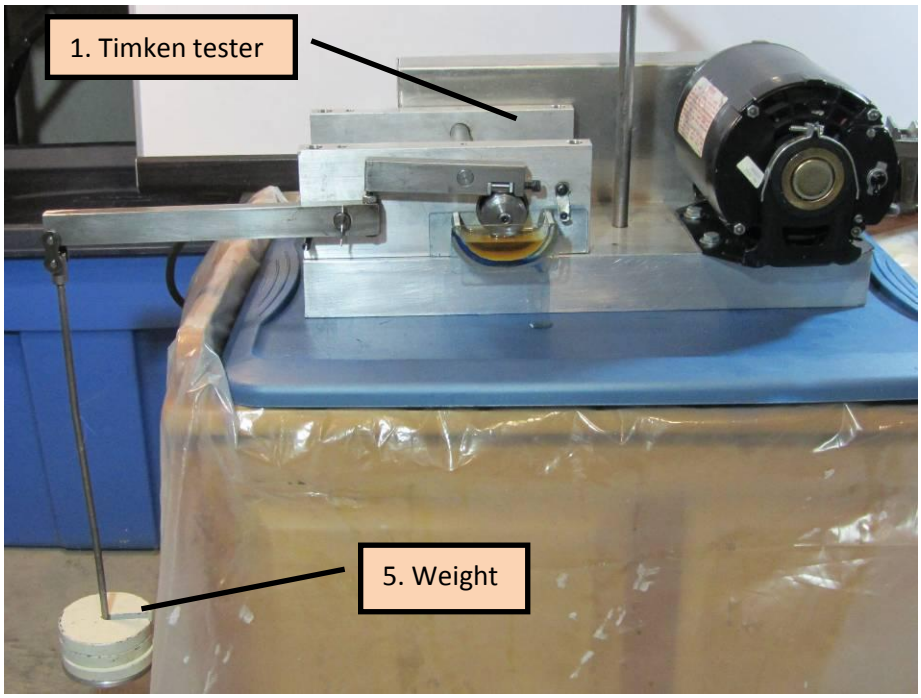
3 Procedure

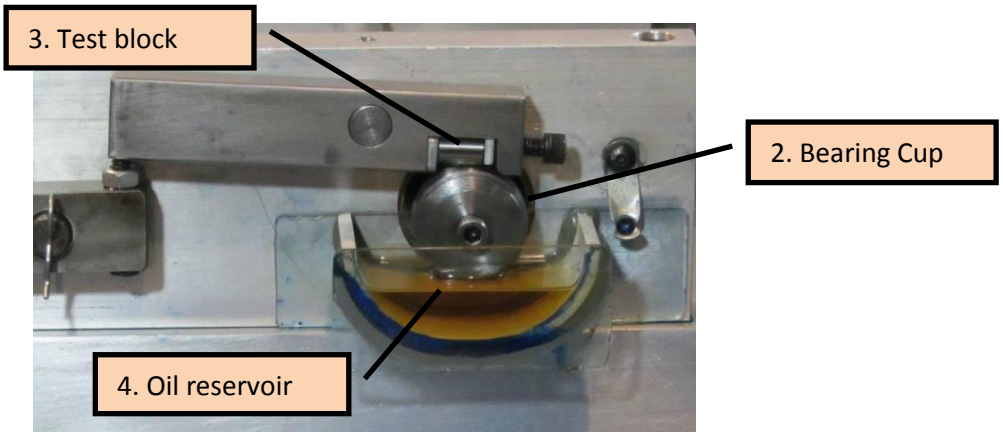
Testing was conducting in reference to ASTM D2782-01: “Standard Test Method for Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)”. The portable Timken load tester provided a good representation of the Timken Method. Several validation tests were conducted using Mobil 1 grade 5W-30 oil. The acceptable repeatability in the Timken Method is

30% of the mean value. My requirements were to be within 15%. The calculation of the pressure load is similar to the Timken Method with the only difference being the shape of the scar.

3.1 Equipment used

1. Portable Timken load tester
2. Bearing cup (Timken A4138)
3. Test block (roller bearing)
4. Oil reservoir
5. Weight
6. Sharpening stone





3.2 Test procedure

1. Install a new bearing cup or stone the outer diameter while motor is on
2. Clean the outer diameter with brake cleaner
3. Install the oil reservoir and fill until oil makes contact with bearing cup
4. Install new test block (roller bearing) into holder
5. Add weights
6. Hold the weight arm up in a position that does not apply load
7. Start the motor and make sure the oil is making contact with the bearing cup
8. Gentle lower the weight arm to apply pressure on the test block against the bearing cup
9. Run until the sound changes then wait 10 seconds
10. Raise the weight arm
11. Stop the motor
12. Removed oil reservoir
13. Stone outer diameter of the bearing cup and clean while motor is on
14. Rotate the test block to a clean area
15. Repeat steps 6-14 until 6 tests have been conducted

Each test set uses fresh oil. Oil was added during the test set when there was insufficient oil to make contact with the bearing cup.

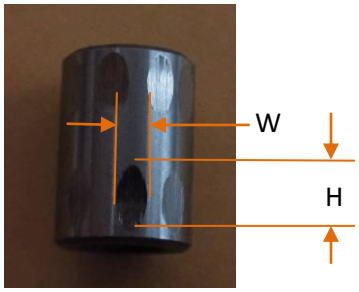
3.3 Measurement and calculation

The resulting scar in the test method is an ellipse. The area of an ellipse is

$$\text{Area} = \pi \times W/2 \times H/2$$

W = width

H = height



Each roller bearing was tested on both ends. For each test set there were 6 tests conducted. The measurements were taken using an 8:1 magnifying lamp and digital calipers. The width and height of each scar was measured and recorded. 5 out of the 6 tests per test set were used to determine the load bearing capability of the oil. The test outliner was removed from the calculation. The

load calculation was the average of 5 tests. If the repeatability was above 15%, then the test set was eliminated from the results and the test was repeated.

The load bearing capacity of the oil was calculated based on the applied force divided by the area of the scar.

Load = Weight X leverage / (Scar Area)

The weight arm has a mass equivalent to 1 pound. The weight arm and holding block has a leverage of 24:1.

The amount of weight per viscosity grade remained the same for all tests for that viscosity.

Grades	Additional test weight
5W-30 / 15W-40 / 20W-50	1 pounds
75W-90	4 pounds

4 Product tested

5W-30

15W-40

20W-50

75W-90

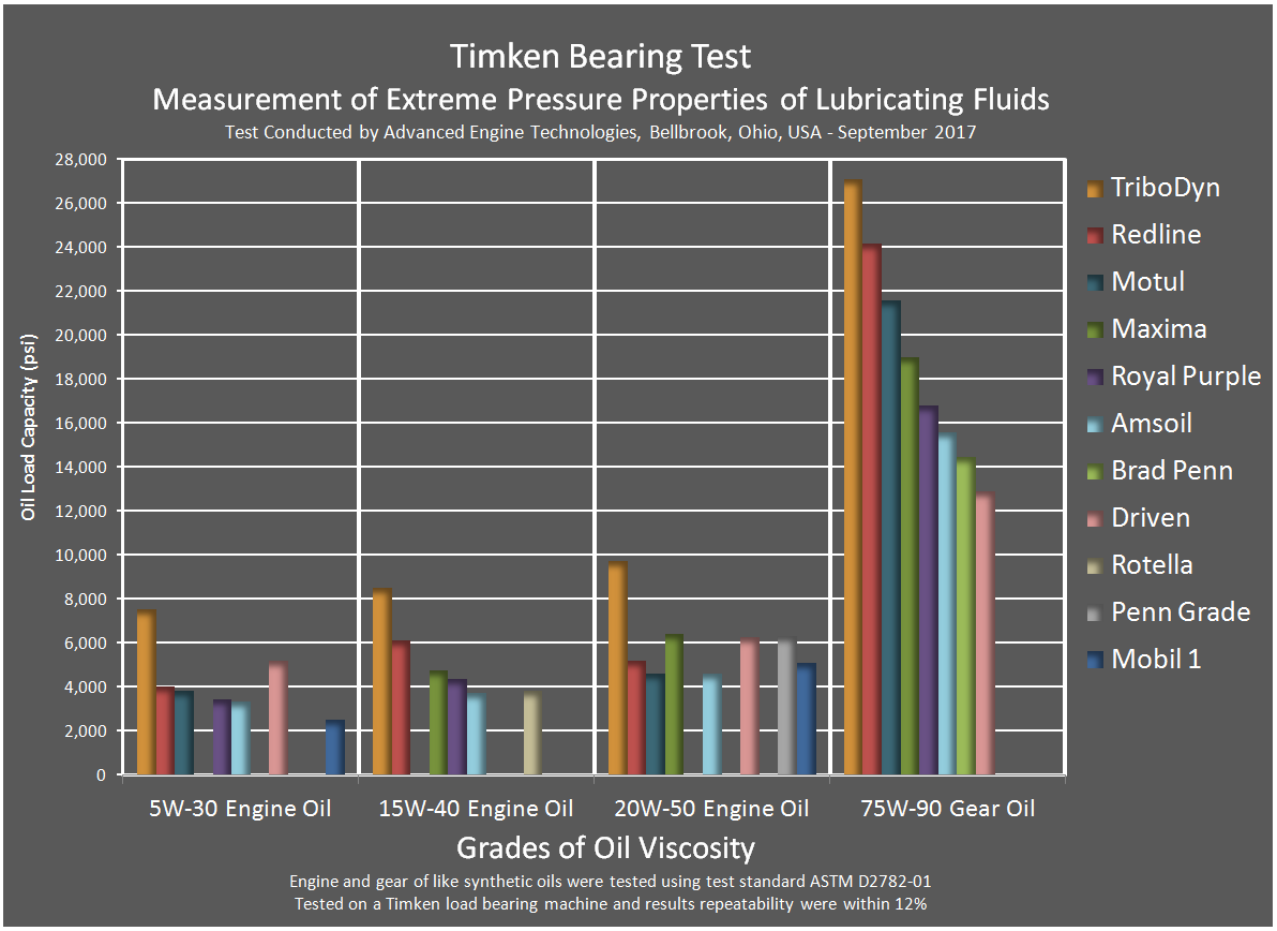
5 Results

The following are the results, pounds/square inch

Manufacturer	5W-30 Engine Oil	15W-40 Engine Oil	20W-50 Engine Oil	75W-90 Gear Oil
TriboDyn	7,520	8,508	9,705	27,091
Redline	4,022	6,105	5,155	24,149
Motul	3,799		4,601	21,580
Maxima		4,745	6,420	18,975
Royal Purple	3,445	4,357		16,764
Amsoil	3,342	3,738	4,605	15,549
Brad Penn				14,439
Driven	5,168		6,248	12,894
Rotella		3,824		
Penn Grade			6,283	
Mobil 1	2,501		5,090	

Results repeatability were within 12%

5.1 Chart



5.2 Example of test results

Bearings are .393” diameter x 0.544” long

Manufacturer	Royal Purple	TriboDyn	Red Line	Maxima
Oil Grade	75W-90	75W-90	15W-40	15W-40
Load Capacity (lbs/in^2)	16,764	27,091	6,105	4,745
Area (in^2)	0.0072	0.0044	0.0079	0.0101
Picture			Bottom 	Top

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