ME4020: Machine Dynamics Lab

Small Engine Rebuild

January 16, 2018

To be conducted in the McElroy Prototyping Laboratory.

1 Objective

Reciprocating machinery is ubiquitous in machinery and understanding the details of their construction is important in that it brings relevance to the modeling of the dynamics of machinery. This lab exercise is to show the student how the internal components of an engine are assembled. Also, the internal engine components will be measured and engineering values assigned.

2 Tasks

Each lab group will be required to disassemble, measure, and rebuild a single cylinder, four stroke, internal combustion engine. These engines are Briggs and Stratton 5hp vertical shaft engines that may be used on a lawn mower. The engine must run at the completion of the lab. Engines can only be started outside on the loading dock. The following measurements or quantities must be obtained to complete the lab. Many of these measurements will require some calculation and further research.

1. Displacement in cubic inches and cubic centimeters
2. Cylinder head volume (in cubic inches)
3. Compression ratio
4. Stroke (in.)
5. Crank to connecting rod journal clearance (in inches)

6. Valve lift for both intake and exhaust (in inches)
7. Spark gap (in.)
8. Ring drag (lb)
9. Mass of the connecting rod (lb-sec^2/in)
10. Moment of inertia estimate of the connecting rod about the wrist pin
11. Center of mass location of the connecting rod
12. Journal Clearance between the connecting rod and the crank shaft
13. Mass of the reciprocating parts (lb-sec^2/in)
14. Mass of the Crank Shaft (lb-sec^2/in)
15. Moment of inertia estimate of the crank shaft
16. Valve lash (in inches)
17. Output shaft size and key way size
18. Flywheel mass (lb-sec^2/in)
19. Estimate of the flywheel moment of inertia
20. Overall cam lift

The lab will be graded in two parts: 60 points for the above measurements and 40 points if the engine starts after reassembling it.

3 Disassembly

Below is a stepwise list of the disassembly process:

1. Drain the oil via the drain plug located on the bottom of the engine case. Catch the drained oil in the specified pan.

2. Drain the fuel from the fuel tank by removing the hose from the fuel tank itself. Catch this fuel in the specified container.

3. Remove the spark plug and measure the gap using a feeler gauge set. Once complete set the plug aside for later reassembly.

4. Remove the outer half of the air cleaner.

5. Remove the air filter. Remove the air cleaner base from the carburetor assembly. Be sure to include the vent hose that is attached to the back of the air cleaner base.

6. Remove the fuel tank assembly by removing the small bolts located around the ring near the pull cord, and then the one bolt underneath the tank attached the block. Do not lose the fuel tank spacer that comes off with this bolt.

7. Remove the muffler.

8. Remove the pull cord assembly and the basket. This is accomplished by removing the four outer most bolts– two at each end.

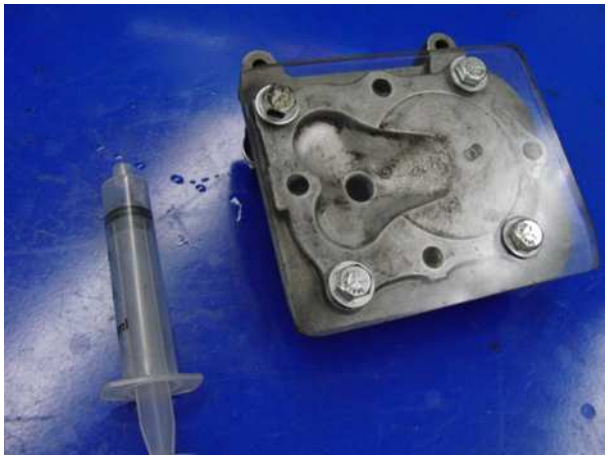
9. Remove the carburetor assembly from the engine by unbolting the 2 bolts that attach the intake manifold to the cylinder. Then remove the 2 bolts that attach the carburetor assembly to the block.

10. Remove the two bolts holding the brake assembly to the block ear. Carefully remove the wire attached to the brake assembly that grounds the coil.

11. Remove the coil. Note: The air gap required for proper coil operation is 0.010”, which is about the thickness of a playing card or note card.

12. Remove the Cylinder head taking extreme care not to damage the head gasket. Once removed measure the cylinder head volume using the supplied fixture and syringe.

    Note: 1mL = 1cc.



13. Remove the large nut holding the flywheel down.

14. Remove the flywheel using the pulley puller. Once removed begin measurements for the required calculations.

15. Measure the bore of the cylinder.

16. 16. Measure the depth of the cylinder with the piston all the way at the bottom of its cycle. This measurement is the stroke.

    a) Calculate the displacement in cubic inches and cubic centimeters. Note: 1 in. = 2.54 cm

    b) Calculate the compression ratio.

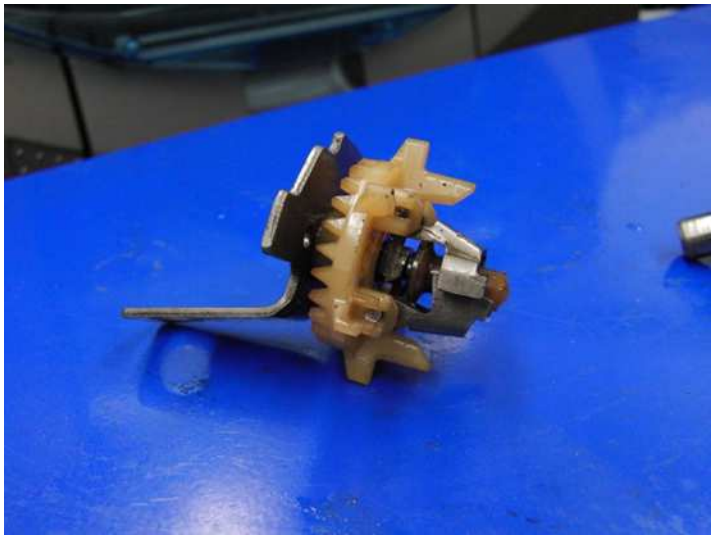
17. Measure the valve lift using a dial indicator mounted on a magnetic base.

18. Remove the valve cover. Taking care not to damage the gasket.

19. Measure the valve lash using the feeler gauges.
20. Remove the valves, springs and retainers taking care not to mix the parts.

21. Remove the side case cover from the block. Taking care not to damage the gasket.

22. Remove the governor idle assembly



23. Remove the camshaft and tappets.

24. Remove the two bolts attaching the connecting rod to the crankshaft.
25. Push the piston assembly up in the cylinder and out of the way for crankshaft removal.
26. Remove the crankshaft. Once removed begin measurements.

27. Measure drag by placing lab weights on the cylinder until it moves.
28. Once complete, remove the piston and rod assembly. Remove the wrist pin from the piston and separate the connecting rod from the piston.

29. Measure the overall volume of the cylinder.
30. Weigh the reciprocating assembly.
31. Measure the output shaft diameter and keyway size.

32. Determine the center of mass of the connecting rod.
33. Measure the journal clearance between the crankshaft and the connecting rod.
34. Obtain any and all other related measurements including weights required to produce accurate estimates.

35. Clean and inspect all the components.

Reassembly is the reverse of the disassembly operation.

4 Reporting Sheet for Engine Rebuild Lab

Please fill in the following table and turn in the sheet to Dr. Daily.

Reporting Sheet for Engine Rebuild Lab	
Name	
Group Members	
Date:	
Time Started:	
Time Finished:	

Measurements with units

Displacement in cubic inches and cubic centimeters	
Cylinder head volume	
Compression ratio	
Stroke	
Crank to connecting rod journal clearance	
Valve lift for both intake and exhaust	
Spark gap	
Ring drag	
Mass of the connecting rod	
Moment of inertia estimate of the connecting rod about the wrist pin	
Center of mass location of the connecting rod	
Journal Clearance between the connecting rod and the crank shaft	
Mass of the reciprocating parts	
Mass of the Crank Shaft	
Moment of inertia estimate of the crank shaft	
Valve lash	
Output shaft and keyway size	
Flywheel mass	
Flywheel moment of inertia	
Overall cam lift	
Did the engine run?	Yes___ or No_____
Signature of lab instructor:	