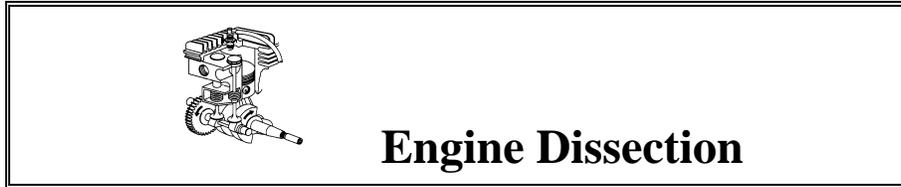


PENN STATE UNIVERSITY
Department of Mechanical & Nuclear Engineering

ME240

PRODUCT DISSECTION: ENGINES

ME107S



Purpose: To understand the function and structure of a four-cycle internal combustion engine.

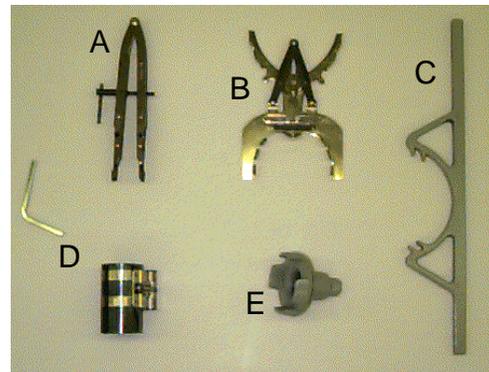
Background and reference material: Briggs & Stratton Service and Repair Instructions, Briggs & Stratton Corporation, Milwaukee, WI, 1992.

Physical principles involved: Bernoulli's principle, combustion, magnetic fields and induction, static and dynamic forces, heat transfer, and lubrication.

Mechanisms involved: carburetor, flywheel, magneto, journal bearings, crank-slider (piston, connecting rod, crank shaft), cams, and valves.

Manufacturing processes introduced: casting, machining, stamping, and molding.

Required tools: basic tools, parts bin, calipers, starter clutch wrench (E), flywheel wrench set (C), ring expander (B), ring compressor (D), valve spring compressor (A), and torque wrench.



Deliverables (at the end of the semester):

1. assembled, working, well-adjusted engine
2. computer generated drawing of the piston
3. detailed journal record of activities:
 - a) record all procedures followed,
 - b) answer all questions,
 - c) sketches of parts and assemblies, and
 - d) all other pertinent information.

Some General Guidelines:

1. Carefully follow all instructions.
2. Use the limited lab time wisely. Come prepared and ready to work. Try not to spend too much time on things you can do later, at home.
3. *Make sure that you return all tools to proper place at the end of each session!*
4. Put all oil, kerosene, or solvent soaked rags and waste materials in the designated metal container (to avoid causing a fire).

Session 0: Getting the Patient Ready

Readings: Briggs and Stratton Repair and Service Manual

Section 1 - General Information

Section 13 - Tools

Section 14 - Theories of Operation

Objectives: a) Understand how to use a factory service manual.
b) Determining engine type and its specifications.

Procedure (record all answers in your journal):

1. Note the manufacturer, model, and serial number of your engine.
2. How much horsepower can it produce?
3. Check that there is no fuel and oil in the engine.
4. Determine if the engine has compression.
5. Check to see if ignition system is functioning.
6. Explain the four cycles in your journal.
7. Draw an overall diagram of your engine (external view of assembled engine), label all important parts.

Session 1: Carburetor and Ignition

Readings: Section 3 - Carburetor
Section 4 - Governor Controls & Carburetor Linkage
Section 2 - Ignition

Objectives: Troubleshoot, disassemble and inspect the carburetor and ignition systems

Procedure (record all answers in your journal):**A. Carburetor**

1. Remove the air cleaner and identify the type used.
2. Why is the air cleaner important?
3. Dissect the air cleaner and sketch all of its parts.
3. Identify the carburetor style (pages 4 - 5 in Section 3).
4. Disassemble the carburetor.
5. What materials are used in the carburetor?
6. Sketch and describe how the venturi works.
7. How many jets are used and what is their function?
8. How does the choke work? How does the throttle work?
9. What type of governor system does this carburetor use? How does it work?
10. Completely dissect the carburetor assembly and governor.
11. Sketch the components of the carburetor and make an assembly diagram in sufficient detail so that you can reassemble it at the end of the course.

B. Ignition System

1. Remove the flywheel shroud.
2. Identify the type of ignition system your engine uses.
3. What materials are used in the flywheel?
4. Remove the flywheel using the proper tools.
5. What is the purpose of the starter clutch? Why does not work in some orientations?
6. How much does the flywheel weigh? What is its function? What would be the advantages and disadvantages of making it heavier?
7. Why does the flywheel have one section made from a different material?
8. Sketch the ignition system in detail, identifying all of its components.
9. Describe how the magneto system works.
10. What is ignition timing and why is it important? How is it achieved in your engine?
11. Make a sketch of the electrical circuit in the ignition system, making sure to label all parts.
12. Remove the rest of the ignition system components and put parts in the bin provided.

Note: Do not reassemble the ignition system or re-mount the carburetor to the engine block; this will be done in the last engine dissection lab.

Session 2: Engine Block and Drivetrain Dissection

Readings: Section 6 - Compression
Section 8 - Lubrication
Section 9 - Pistons, Rings, Rods
Section 10 - Crankshafts & Cam Gears

Objectives: a) Disassemble, inspect and document the internal mechanisms of an I.C. engine.
b) Calculate the displacement and compression ratio of the engine.

Procedure (record all answers in your journal):

1. Remove the cylinder head.
2. Locate the intake and exhaust valves. Are there any differences between them? Explain the differences and the reasons for them.
3. Sketch the top view of the cylinder (include the valves).
4. Rotate the engine through its four cycles. Note what happens if you turn it the wrong way.
5. Calculate the displacement of the engine _____ cubic inches = _____ cc.
6. Explain how you would determine the compression ratio analytically and experimentally. Then pick one method and compute the compression ratio for your engine, explaining how it was done.
7. Remove the valves. **Use your safety glasses!!**
8. Remove the crankcase cover, being careful not to damage the gasket; do not try to pry it off with a screwdriver, it will tear!
9. Remove the camshaft and crankshaft.
10. What materials are used for the camshaft? How are the cams and gears fastened to the shaft?
11. What is the significance of cam timing? How is it set?
12. What are tappets and what function do they serve?
13. What type of lubrication system does your engine have and how does it work? Which components receive lubrication and how?
14. Sketch the camshaft assembly.
15. Remove the piston.
16. Remove the piston rings (using the ring expander) and identify them. **Use your safety glasses!!**
17. Remove the wrist pin and connecting rod.
18. Sketch the piston assembly, including the piston, wrist pin, piston rings, and connecting rod.
19. What manufacturing processes do you think are used to produce the crankshaft, camshaft, connecting rod, wrist pin, and piston?
20. Remove the crankshaft. What type of bearings does it use? How is the piston connected to the crankshaft? Sketch the crankshaft assembly.
21. What material is used for the crankshaft?

This completes the engine disassembly.

Session 3: Reassemble the Engine**Readings:** Section 12 – Synchro-Balance**Objectives:** a) Reassemble the engine (with no parts left over!).
b) Adjust it to factory specifications.
c) Run the engine.**Procedure (record all answers in your journal):**

Note: Use small amounts of engine oil to lubricate mating parts (bearings, rings etc.). **The service manual must be followed exactly during reassembly.**

1. Reassemble your engine. Install parts in the reverse order which you disassembled them (this is a test of your memory, journal completeness, and common sense). If there are any parts that need replacing before reassembly, please inform the instructor so that new parts can be purchased.
2. Use the ring compressor to reassemble the piston rings.
3. **Torque all bolts exactly to the factory specification!** Write in the required torque values (and the correct units!) in your journal for the:
Crank bolts _____ Head Bolts: _____
Flywheel _____
4. What grade bolts are used for the connecting rod (search web for SAE & ASTM bolt grade)?
5. Why is it important to torque the bolts to a certain value? How is this value determined?
6. Why are the bolts torqued in a certain pattern? Sketch and describe the proper pattern.
7. What is the purpose of the head gasket?
8. Prepare to run you engine!
9. Fill the engine with oil and gas (only enough gas to run the engine for a minute or two).
10. While it is running you should adjust the air/fuel mixture, idle speed, and governor to reach a good steady speed. Know these procedures before you start!
11. Does your engine operate smoothly? If not, you must make whatever adjustments are needed to ensure that the engine is running properly.
12. What happened when you changed the air fuel mixture?
13. What is the steady-state RPM for your engine? What torque does the engine deliver at this RPM (recall horsepower from Session 0 and the relationship: $P = T\omega$)?
14. After running the engine, drain the fuel and oil from it.

The engine will be inspected and tested during the last week of class.