Small Engine Assembly – Notes

Day 1

1. Remove head gasket residue  
   gasket scraper
   • Use the gasket scraper to remove the head gasket residue from the block and head
   • Be sure not to dig into block while using the gasket scraper

2. Remove oil sump pan/crankcase gasket residue  
   gasket scraper
   • Use the gasket scraper to remove the oil sump/crankcase gasket residue from the block and oil sump pan

3. Clean the engine with hot soapy water and dry thoroughly

4. Install crankshaft  
   lubriplate grease
   • Lubricate all the journals on the crankshaft and the bearing on the oil sump pan with lubriplate grease
   • Install by pushing the magneto end of the crankshaft into the block

5. Install wristpin  
   plastic mallet, punch and lubriplate grease
   • Be sure the metal tab on the connecting rod aligns with the notch on the top of the piston
   • Lubricate wrist pin with lubricate grease
   • Be sure to start the wrist pin back through the piston correctly (from the end where the snap/keeper ring goes)
   • Use the plastic mallet to tap the wrist pin through the piston and connecting rod. Then use the plastic mallet and punch to complete the installation of the wrist pin.

6. Install snap/keeper ring  
   long nose pliers
   • Use the long nose pliers to install the snap/keeper ring
7. Check ring gap
   - Put the rings into the cylinder one at a time using a piston to push the ring down into the cylinder approximately 1”
   - The ring gap should be no larger than:
     - .045 oil ring
     - .035 compression rings
   - To avoid scratching the cylinder when removing the rings rotate the rings and squeeze ends together before pull the ring out

8. Install rings
   - Be sure not to break the rings by spreading them too far apart
   - Replace the oil ring spring affair and squeeze ends together
   - Spread the oil ring with your thumbs or a ring expander and slide into place over top of the oil ring spring
     - The oil ring has no top or bottom it can go either way
   - Spread the oil scrapper ring with your thumbs or a ring expander and slide into place
     - Be sure the square notch is pointing down and outward toward the cylinder wall
   - Spread top compression ring with your thumbs or a ring expander and slide into place
     - Be sure if it has a beveled/sloped edge it is pointing up and towards the piston (opposite of what the video says)
   - Be sure to evenly space ring gaps around piston
   - Be sure to avoid putting the ring gap directly over the piston pin

9. Lubricate cylinder wall
   - Use the lubriplate grease to lubricate the cylinder wall
10. Lubricate the piston head with motor oil
   • Dip the piston head into motor oil
   • Allow some of the oil to drain off

11. Install piston ring compressor
   • Turn the crankshaft so that the throw of the crankshaft is in the down position
   • Place the piston into the cylinder
     ➢ **Be sure the notch on the piston is pointing up towards the top (magneto side) of the engine**
   • Use the ring compressor to compress the rings
     ➢ Loosen the ring compressor to allow it to slide over the piston and rings
     ➢ **Be sure the crimped side of the ring compressor is facing down towards the block**
     ➢ Place the ring compressor over the piston and rings
     ➢ Tighten the ring compressor to fully compress the rings
       ➢ **Be sure the ring compressor doesn’t slip up on the piston while your are tightening the ring compressor**
   • Use your thumbs to push the piston down into the cylinder
   • Remove the excess oil from the piston head

12. Install rod cap with lubriplate grease, 5/16” socket and inch pound torque wrench
   • Push the piston down into the cylinder to engage connecting rod to crankpin journal
   • Lubricate the crankpin journal and rod cap
   • Install rod cap
     ➢ **Be sure the rod cap is installed correctly**
   • Install and finger tighten the rod bolts
   • **Torque the rod bolts to 100 inch pounds**
     ➢ **Be sure to tighten the bolts evenly alternating between the two rod bolts**
13. Install tappets lubriplate grease
   • Be sure to install the tappets into their original place
     ➢ The exhaust tappet should have been labeled with an “X” on a piece of tape
   • Lubricate the tappet shafts with lubriplate grease
   • Install the tappets

14. Install camshaft lubriplate grease
   • Lubricate the camshaft journals
   • Be sure to properly align the groove on the camshaft with the dot on the crankshaft when installing the camshaft

15. Install the oil slinger
   • Install the oil slinger by sliding it over the end of the camshaft gear
   • Be sure to align the teeth of the oil slinger with the teeth of the camshaft gear

16. Install the oil sump pan/crankcase and gasket 3/8” socket, speed handle, inch pound torque wrench and lubriplate grease
   • Install the oil sump pan/crankcase gasket over the metal pins
     ➢ Be sure the gasket lines up with the holes in the block
   • Lubricate all the journals of the oil sump pan/crankcase cover with lubriplate grease
   • Install the oil sump pan/crankcase cover over the crankshaft
   • Install oil sump pan/crankcase cover bolts and finger tighten
     ➢ Torque the bolts in a star/criss-cross pattern
       ▪ Oil sump pan/crankcase cover should be torqued to 85 inch pounds
     ➢ Be sure not to over tighten the oil sump pan/crankcase cover bolts
Day 2

17. Install valves, valve springs and valve spring keepers

   valve spring compressor and flat screwdriver

   • Be sure to put the correct valve spring and valve spring
     keeper on the correct valve
       ➢ The stronger spring goes on the exhaust valve

   • Place the valve spring and valve spring keeper in the valve
     spring compressor
     ➢ Be sure the valve spring keeper is turned the
       correct way
     ➢ Use a flat screw driver and turn the keeper so that
       oblong hole is aligned with the valve spring
       compressor and the notch is facing the body of the
       valve spring compressor or the outside of the engine
       ➢ This opposite of what the video said

   • Lubricate valve stems with lubricate grease

   • Insert the valve (either valve) through the appropriate valve
     guide while holding the valve spring and valve spring
     keeper with the valve spring compressor
     ➢ Hold pressure against the valve stem with the valve
       spring compressor and loosen the valve spring
       compressor
     ➢ Remove the valve spring compressor

   • Be sure the valve spring and keeper are properly
     aligned and caught on the valve stem

   • Repeat the process for the other valve

18. Check valve-to-tappet clearance       flat feeler gauge

   • To check valve clearance the piston needs to be ¼” down on
     the power stroke

   • Using the feeler gauge measure the distance between the
     valve stem and the tappet
     ➢ Intake valve clearance should be .005 to .007
     ➢ Exhaust valve clearance should be .007 to .009
19. Install flywheel
   • Inspect the flywheel key to see if it needs to be replaced
   • Place the flywheel key on the crankshaft
   • Place the flywheel over the crankshaft

20. Install starter cup
    15/16” socket, foot pound torque wrench and flywheel holder
    • Place starter cup over the flywheel and crankshaft
    • Hand tighten flywheel nut
    • Install the flywheel holder to hold the flywheel when tightening the flywheel nut
    • Use the foot pound torque wrench and 15/16” socket to torque flywheel nut while holding the flywheel holder
      ➢ Torque flywheel nut to 55 ft pounds

21. Install armature and air vane governor
    ¼” socket and nut driver
    • Look for writing on armature to indicate this side out
    • The spark plug wire is also on the top and outside
    • Place the armature and air vane governor on the studs as far away from where the flywheel be as possible
    • Use the ¼” socket and nut driver to tighten the armature bolts

22. Set the air gap
    ¼” socket and feeler gauge
    • Identify where the strongest magnet is located on the flywheel
    • Rotate the flywheel until the strongest magnets are towards the armature
    • Place a feeler gauge between both legs of the armature and the flywheel
      ➢ The magnets on the flywheel will hold the feeler gauges in place
    • Use the ¼” socket and nut driver to loosen the bolts to the armature
      ➢ The magnets on the flywheel will pull the armature to the feeler gauge and the flywheel
    • Use the ¼” socket and nut driver to tighten the armature and governor
    • Rotate the flywheel and remove the feeler gauge
23. Install head and throttle assembly gasket scraper, ½” socket and inch pound torque wrench

- **Be sure to use a new head gasket**
- Use the gasket scraper to scrap the head gasket residue from the head if you haven’t already done so
- Clean the head with hot soapy water and dry thoroughly if you haven’t already done so
- Place the new head gasket on the engine block
  - **Be sure the holes in the gasket line up properly**
- Place the head and throttle assemble over the head gasket
- Place the head bolts into the and finger tighten them
  - **Be sure to replace the head bolts into their original location**
- Use the manufacturer’s recommended sequence to torque the head bolts to 100 inch pounds
  - See repair manual or video for recommended sequence
- Using the manufacturer’s recommended sequence re-torque the head bolt to 140 inch pounds
  - See repair manual or video for recommended sequence
  - The final amount the head bolts should be torqued is 140 inch pounds
Day 3

24. Install the valve chamber breather/crankcase breather and gasket 
   - \( \frac{1}{4} \)” socket
   - and nut driver
   - Be sure the gasket is lined up correctly
   - Be sure not to over tighten

25. Install spark plug 
   - spark plug socket, ratchet and round wire gauge
   - Check and correct the spark with a round wire gauge
     - The spark plug gap should be .030
     - If it is too wide bend together and recheck
     - If it is too narrow widen and recheck
   - Hand tighten the spark plug first
   - Use the spark plug socket and ratchet to tighten the spark plug
     - Be sure not to over tighten
   - Install spark plug wire

26. Install the muffler and gasket (if it has a gasket) 
   - 7/16” socket, ratchet, punch, and plastic mallet
   - Use the 7/16” socket and ratchet to tighten the muffler bolts
     - Be sure not to over tighten the muffler bolts
   - Use the punch and plastic mallet to bend the tabs over (on some engines)

27. Install fuel tank 
   - \( \frac{1}{2} \)” socket and nut driver
   - Use the \( \frac{1}{2} \)” socket and nut driver to install the fuel tank

28. Install carburetor O-rings
   - Be sure the O-rings (2) are installed correctly onto the blow-by tube
     - The black rubber O-ring goes on first (inside the carburetor) then the white plastic O-ring

29. Reconnect the carburetor linkages
   - Turn/tilt the carburetor to the side to help in connecting the carburetor linkages to the air vane governor
• Be sure not to use pliers when reconnecting the spring linkages
• **Be sure not to bend the carburetor linkages**

30. Install the carburetor and gasket **4-way screwdriver**
  • Use the 4-way screwdriver to install the carburetor and gasket
  • Be sure the carburetor gasket is installed correctly

31. Reconnect the kill switch
  • Push up on the small brass tab

32. Install blower housing and dipstick tube **3/8” and ¼” socket ratchet and speed handle**
(on some engines)
  • Use the 3/8” socket and speed handle to install the blower housing
    ➢ Be sure metal shield are in place
    ➢ Be sure not to over tighten
  • Use the ¼” socket and ratchet to install dipstick tube (on some engines)
  • Pull the starter rope and make sure the recoil starter is working properly

33. Check the ignition system **spark tester**
  • Use the spark tester to check the ignition system
  • **Be sure the kill switches are disengaged**

34. Install air filter **flat screwdriver**
  • Use the flat screwdriver to install the air filter

35. Refill with oil **oil and funnel**
  • Check the oil level and adjust accordingly
    ➢ **Be sure not over fill with oil**

36. Refill with gasoline **gasoline and funnel**
  • Fill at least half full

37. Start engine
38. Prepare for long-term/winter storage spark plug socket, ratchet, and oil

- Start the engine and let it run until it runs out of gasoline
- Remove the gas tank and drain any gas that is remaining in the tank
- Remove the spark plug and squirt a small amount of oil into the cylinder and crank the engine 3 times