

## 2<sup>nd</sup> Packet

Name: \_\_\_\_\_ Engine #: \_\_\_\_\_  
 Trimester: \_\_\_\_\_ Class Period: \_\_\_\_\_

- **It is not a race.**
- **This is a step-by-step reassembly process. Take your time when assembling the engine and listen for direction from the instructor**
- **Do not work ahead!**
- **Fasteners must be torqued to the proper torque value**
- **Special procedures will be explained**

REASSEMBLY							
General Instructions			TORQUE		Page #		
<ul style="list-style-type: none"> <li>• Remove old gasket material and clean parts to be reused</li> <li>• <b><u>Follow all torque values listed in column 5 during the reassembly process – place a check in the space to the left if you read and understand this!</u></b></li> <li>• Clearance adjustments are required for the valves and armature air guide and are also listed in column 5</li> <li>• A special adjustment procedure is performed for the governor system</li> <li>• Lubricate all moving parts upon assembly</li> </ul>							
<b>29</b>	Install Governor Cup/Spool (if removed)		Hand				
<ul style="list-style-type: none"> <li>• Make sure thrust washer is under cup</li> <li>• Turn governor crank so paddle is against governor cup</li> <li>• Make sure crankcase cover dowel pins are installed in crankcase</li> </ul>							
<b>30</b>	Install Crankshaft		Hand				
<ul style="list-style-type: none"> <li>• Crank gear has a “dot” on a tooth that must face out</li> <li>• Carefully, make sure governor gears mesh with each other so plastic governor gear is not damaged by steel gear on crankshaft</li> </ul>							
<b>31</b>	Install Piston and Connecting Rod Assembly		19070 Ring Compressor				
<ul style="list-style-type: none"> <li>•</li> </ul>							

<b><i>Int.</i></b>	<ul style="list-style-type: none"> <li>Lubricate piston assembly, rings, ring grooves, cylinder wall and ring compressor with oil</li> <li>Set piston into bore. Be sure orientation marks (notch or triangle) on the piston crown faces toward the push rods</li> <li>Unwind ring compressor far enough to stretch it over the piston/ring assembly. Do not unwind too far or tool will be damaged</li> <li>Slide compressor over piston far enough that it covers all the rings</li> <li>Firmly tighten ring compressor, compressing rings into the ring grooves. Remove piston assembly from bore and inspect that all rings are captured and compressed. Adjust compressor position on piston to accomplish this if necessary</li> <li>Position piston in bore and crankshaft in block so that the piston/connecting rod assembly will not be impeded when pressed into the bore</li> <li>Gently tap on the upper edge of the compressor to make sure the bottom edge is in contact with the cylinder at all points</li> <li>Press firmly and <u>steadily</u> on top of piston sliding it from the compressor into the cylinder bore. Do not let up until piston is completely in the bore. If it stops before it completely enters the bore, a ring has popped out from the compressor and failed to enter the bore</li> <li><u>Do not</u> hammer piston assembly into block or rings may be damaged. If you cannot push the piston in by hand or if a ring has popped out, reset the ring compressor and try again. Multiple tries is not uncommon for the novice</li> </ul>						
<b>32</b>	Install Connecting Rod Cap	Screw 2x	8mm	125 lb in 17.5Nm			
<b><i>Init</i></b>	<ul style="list-style-type: none"> <li>Align Match Marks on rod cap and rod and install rod cap screws</li> <li>Carefully torque rod cap screws</li> <li>Rotate crankshaft by hand after assemble to insure there is no binding. <b>Use caution. The edges of the crankshaft key way are very sharp</b></li> </ul>						
<b>33</b>	Install Tappets		Hand				
	<ul style="list-style-type: none"> <li>Tip cylinder assembly on its side or turn upside down to prevent tappets from falling out</li> </ul>						
<b>34</b>	Install Cam Gear		Hand				
<b><i>Init</i></b>	<ul style="list-style-type: none"> <li>Make sure compression release mechanism moves freely and the return spring is in position</li> <li>Note mark on cam gear in the valley between 2 teeth. This aligns with the dot on the crankshaft gear. Orienting these marks establishes the internal timing of the engine by assuring the valves will open and close at the correct time in relation to the piston location in the cylinder bore</li> </ul>						
<b>35</b>	Install Crankcase Cover	Screw 6x	10mm	210 lb in (25 Nm)			

<b><u>Init</u></b>	<ul style="list-style-type: none"> <li>The clearance between the crankshaft and main bearing and the bearing races and block/cover is a clearance fit. If the alignment is off even slightly, the cover will bind during reassembly. If this occurs, do not force the cover on. Make sure the cover is perpendicular to the crankshaft axis and it will slide right into position</li> <li>Torque sequence in o'clock positions: Screw at 3:00 position is number 1  Number 2: 9:00  Number 3: 5:00  Number 4: 10:00  Number 5: 7:00  Number 6: 1:00</li> <li>When finished, rotate crankshaft through several complete revolutions to check for binding</li> </ul>						
<b>36</b>	Check Crankshaft Endplay		Dial caliper	.003-.030 in (.09-.075 mm)			
<ul style="list-style-type: none"> <li>Pump applications require endplay of .002-.009 in. This is adjusted by adding shims between the crank gear and the pto ball bearing</li> <li>If endplay is too much on standard engines, the crankcase cover must be replaced</li> </ul>							
<b>37</b>	Assemble Cylinder Head	Screw 1x	8mm	30 lb in (3.4 Nm)			
<ul style="list-style-type: none"> <li></li> </ul>							

<b><u>Init</u></b>	<ul style="list-style-type: none"> <li>• Lubricate the valve stems with oil and insert the valves into the valve guides from the combustion chamber side. The larger valve is always the intake valve and the smaller, the exhaust. These valves have an “E” or an “H” embedded in the part number on the top of the valve to help identify them as exhaust or intake</li> <li>• Bunch up a rag and push it into the combustion chamber then put the cylinder head on the work bench with the rag and combustion chamber against the bench surface. The rag is there to apply pressure against the valve so the head can be reassembled</li> <li>• Slide the stem seal – flat side in – along the <u>intake</u> valve stem. When the piston drops down in the bore during the intake stroke, the low pressure area created can draw oil along the valve stem and into the combustion chamber raising exhaust emissions. The stem seal acts like a “squeegee” and prevents the oil migration. It is usually not necessary on the exhaust valve although some engines have a seal on both.</li> <li>• The head plate was not removed but if it was, install it and torque the studs to 125 lb. in.</li> <li>• Set a valve spring down over the stem seal and a retainer on top of the spring. Make sure you have safety glasses on. Compress the spring by pressing down on the retainer. At the same time, guide the end of the valve stem through the larger hole in the retainer. Continue to press down until the narrower center hole through the retainer can be slipped into the slot in the valve stem</li> <li>• The procedure is the same for the exhaust but there is no stem seal.</li> <li>• Once springs are installed, make sure the axis of the spring is parallel to the valve stem. If the spring is cocked, the valve guide will wear prematurely</li> <li>• <b><u>Get initials from Instructor before next step</u></b></li> </ul>						
<b>38</b>	Install Cylinder Head and Dowel Pins	Screw 4x	12mm	210 lb in (23.5 Nm)			
	<ul style="list-style-type: none"> <li>• Set head gasket onto dowel pins</li> <li>• Make sure valves, springs and retainers are installed</li> <li>• Rotate engine so piston is at top dead center</li> <li>• Step Torque Head Bolts; 70 lbs in, 140 lbs in, 210 lbs in</li> <li>• Torque sequence: Top right Bottom left Top left Bottom right</li> </ul>						
<b>39</b>	Install Remaining Valve Components	Nut 2x	Hand 10mm				

	<ul style="list-style-type: none"> <li>Slide pushrods through sheet metal plate and seat the ends into the recess in the tappets. Inspect pushrod ends. If one appears to protrude from the head further than the other, turn crankshaft 360 degrees</li> <li>Install 2 valve stem caps – do not drop them as they may end up in the crankcase!</li> <li>Slide rockers over the studs, thread adjusters on to stud and follow with locking nut</li> <li>Align rockers with push rod and valve stem cap. Lightly snug adjuster nut against rocker and then the locking nut against the adjuster</li> </ul>						
<b>40</b>	Position Piston for Valve Adjustment		Pencil, Popsicle Stick, Wood Dowel				
	<ul style="list-style-type: none"> <li>If piston was set to TDC and pushrods were at even lengths from steps above, insert something like a popsicle stick or soda straw into the spark plug hole, until it contacts the top of the piston. Rotate the crankshaft counter clockwise when viewed from the PTO until the stick drops ¼ in. Valve clearance on Briggs &amp; Stratton engines is adjusted when the piston is ¼ in past top dead center on the power stroke.</li> </ul>						
<b>41</b>	Set Valve Clearance	Nut 2x Nut 2x	Feeler gage 10mm 14mm	.004-.006 in .006-008 in 70 lb in (7.9 Nm)			
<b><i>Init</i></b>	<ul style="list-style-type: none"> <li>If piston was set to TDC and pushrods were at even lengths from steps above, insert something like a popsicle stick or soda straw into the spark plug hole, until it contacts the top of the piston. Rotate the crankshaft counter clockwise when viewed from the PTO until the stick drops ¼ in. Valve clearance on Briggs &amp; Stratton engines is adjusted when the piston is ¼ in past top dead center on the power stroke.</li> <li>For the intake valve, rotate the .004, .005 and .006 in leaves from the closed gage. Insert the .005 blade between the stem cap and the rocker. Loosen or tighten the adjustment nut until there is a slight drag on the blade. Push down on the nut while checking the clearance to simulate the pressure the locking nut will apply. Snug down the locking nut and recheck. If too tight using the .005 blade, check with the .004. If too loose, check with the .006. If either of the other blades offers a slight drag, you are still within tolerance so the setting is acceptable. When complete, torque lock nut to 70 lb in (7.9 Nm)</li> <li>Repeat procedure for the exhaust valve using .006, .007 and .008 feeler gage blades.</li> <li><b><u>Stop. Get approval</u></b></li> </ul>						
<b>42</b>	Install Valve Cover	Screw 4x	8mm	80 lb in (9Nm)			
	<ul style="list-style-type: none"> <li>Torque sequence: Top right Bottom left Top left Bottom right</li> </ul>						
<b>43</b>	Install Finger Guard and	Screw 1x	8mm	85 lb in			

	Low Oil Module			(9.6Nm)			
	<ul style="list-style-type: none"> <li>Screw is 20mm long</li> </ul>						
44	Install Cylinder Air Guide	Screw 2x	8mm	50 lb in (5.6Nm)			
45	Install Flywheel	Nut 1x	19433 Strap	65 lb ft (88Nm)			
	<ul style="list-style-type: none"> <li>Never oil flywheel or crankshaft tapered joint surfaces. Make sure surfaces are clean and dry</li> <li>Starter cup extrusion must align with hole in flywheel</li> <li>Pins on back of flywheel fan must seat into corresponding holes in flywheel`</li> </ul>						
46	Install Ignition Armature	Screw 2x	10mm	.012 in (.3mm) 95 lb in (10.7Nm)			
	<ul style="list-style-type: none"> <li>Set air gap between armature lamination stack and magnet on flywheel</li> <li>Torque bottom screw first</li> <li>Screws are 25mm</li> </ul>						
47	Install Blower Housing and Wiring	Screw 4x	8mm	85 lb in (9.6Nm)			
	<ul style="list-style-type: none"> <li>Switch terminal 1: red ground wire at top of block</li> <li>Switch terminal 2: wire to ignition armature</li> <li>Switch terminal 3: wire to low oil sensor</li> <li>Torque sequence: Bottom right Bottom left Top left Top right</li> </ul>						
48	Install Rewind	Screw 3x	8mm	30 lb in (3.4Nm)			
	<ul style="list-style-type: none"> <li>Mount in the 9:00 position</li> </ul>						
49	Install Spark Plug		16mm	180 lb in (20.3Nm)			
50	<ul style="list-style-type: none"> <li>Reattach spark plug boot</li> </ul>						
51	Mount Carburetor		Hand				
	<ul style="list-style-type: none"> <li>Slide "D" shaped gasket on studs</li> <li>Add plastic isolation block</li> <li>Add second gasket</li> <li>Install Carburetor</li> <li>Mount air cleaner base gasket</li> <li>Seat high tension lead into groove on top of isolation block</li> </ul>						
52	Install Speed Control Bracket	Screw 2x	8mm	85 lb in (10.7Nm)			

	<ul style="list-style-type: none"> <li>• Turn bracket upside down</li> <li>• Install long end of spring through hole marked during disassembly</li> <li>• Check hook at other end of spring – the short end should be up</li> <li>• Mount bracket</li> <li>• Engage short end of spring into hole “G” on governor arm</li> <li>• Screw that attaches bracket at base of fuel tank also goes through the eyelet of the red wire that goes down to the ignition armature. Check your picture library for correct routing</li> </ul>						
<b>53</b>	Install Governor Arm	Nut 1x Bolt 1x	10mm				
	<ul style="list-style-type: none"> <li>• The governor arm clamps around the splines of the shaft. Because of the clamping force imparted when the nut is torqued, the fit of the arm against the shaft is tight. If we push it back on in its compressed condition, the clip will probably be dislodged from the slot and we run the risk of the governor spool falling off. To avoid this, spread the slot of the governor arm open slightly so the arm will easily fit over the shaft. Back the Nyloc nut off a few turns, slide a screwdriver into the legs of the arm and gently pry the legs apart to increase the hole size for the shaft.</li> <li>• Test fit the arm on the shaft to make sure it is a smooth, slip fit. The arm should slide onto the shaft and sit on top of the clip. If OK, remove arm, turn Nyloc nut onto the threads until it just touches the governor arm, insert the governor spring into hole #3 for this engine model and type and slide arm back onto governor shaft. The spring loop opening should be down.</li> <li>• The solid link has a Z bend on one end and an L bend on the other. Insert the Z bend into hole G of the governor arm from the top. Engage the L-shaped end of the link with the throttle shaft of the carburetor</li> <li>• Attach the loop of the link spring in hole F of the governor arm</li> <li>• Attach the other loop of the link spring to the small hole in the throttle shaft</li> <li>• Leave the governor system alone for now. It will be adjusted later</li> </ul>						
<b>54</b>	Install Air Cleaner Base	Nut 2x Screw 1x	10mm 8mm	40 lb in (4.5Nm) 50 lb in (5.6Nm)			
	<ul style="list-style-type: none"> <li>• Get nuts and screw started before tightening either</li> <li>• Install breather hose between valve cover and air cleaner backing plate</li> </ul>						
<b>55</b>	Perform Static Governor Adjustment	Nut 1x	10mm Pliers Torque Wrench	40 lb in (4.5Nm)			
	<ul style="list-style-type: none"> <li>• A static governor adjustment must be performed whenever the governor system is disturbed such as when replacing parts like links or springs or removing and reinstalling the carburetor. It is a static adjustment, so is performed with the engine not running and is only necessary on mechanically governed engines</li> <li>• The purpose is to make sure the “paddle” on the governor crank is tight up against the governor spool on the inside of the crankcase.</li> </ul>						

	<p>This assures that any movement of the spool is transferred to the carburetor throttle shaft, therefore providing reliable throttling and speed control as engine loads are applied. The question is always what direction do I turn the shaft to make the adjustment?</p> <ul style="list-style-type: none"> <li>• Use the following procedure to determine which direction to turn the governor shaft to adjust the governor. This works for <u>all</u> Briggs &amp; Stratton engines</li> <li>• Place the <u>throttle control</u> in the “fast” position. All static governor adjustments are made with the throttle in the fast or wide open position</li> <li>• Manually move carburetor throttle <u>shaft</u> to the idle position (throttle plate closed) and then turn it from the idle to fast speed position (throttle plate wide open)</li> <li>• As the throttle shaft travels from idle to wide open, watch for a rotating movement of the governor lever and governor shaft. This will occur because of the linkage that ties the throttle shaft to the governor arm</li> <li>• Whichever direction the shaft rotates in is the direction to turn the governor shaft when performing the static governor adjustment. If lever rotates counterclockwise when the throttle shaft is moved from idle to wide open, rotate governor shaft counter clockwise when making the adjustment</li> <li>• Once direction is determined, the actual adjustment is simple. Static governor adjustments are always performed with the throttle set in the fast or wide open throttle position so turn the throttle control to the fast position or hold the governor arm so the throttle is wide open. Now, turn the governor shaft in the direction discovered above until it stops. Hold the governor arm steady and tighten, then torque the pinch bolt nut. Be careful when tightening the nut that the arm does not move. <b>TIP:</b> hold the governor arm tight with your hand at wide open throttle while tightening the nut. Because the nut is not on the centerline of the governor shaft, any torque on the nut will tend to push the governor arm to one side or the other, ruining your adjustment.</li> <li>• The governor shaft will only rotate about an 1/8th turn or less from stop to stop so don't force it to turn further</li> </ul>						
56	Install Air Cleaner Assembly		Hand				
	<ul style="list-style-type: none"> <li>• Install sealing washer at air cleaner element base</li> <li>• Install element</li> <li>• Install wingnut</li> <li>• Install air filter cover</li> <li>• Install air cleaner knob</li> </ul>						
57	Install Fuel Tank	Screw 1x Nut 2x	8mm 12mm	85 lb in (9.6Nm)			



				100 lb in (11.3Nm)			
	<ul style="list-style-type: none"> <li>• Attach fuel line and fuel clamp</li> <li>• Install 30mm screw from cylinder head side first</li> <li>• Secure other side of tank with nuts</li> <li>• <b>Make sure governor spring, link, link spring or governor lever do not make contact with fuel line or tank in any fashion</b></li> </ul>						
<b>58</b>	Connect Low Oil Sensor Wires		Hand				
	<ul style="list-style-type: none"> <li>• Make sure the wires are routed through the channels on the block they were originally seated in</li> </ul>						
<b>59</b>	Install Muffler		13mm	95 lb in (10.7 Nm)			
	<ul style="list-style-type: none"> <li>• Fasteners are nuts and lock washers</li> </ul>						
<b>60</b>	Install Trim Panel		8mm	30 lb in (3.4Nm)			
	<ul style="list-style-type: none"> <li>• Left hand side of panel hinges into air cleaner base. Screws are usually black</li> <li>• First screw to install is that above the rewind. Push gently to the left while installing screw to aid panel in locking in to the air cleaner cover</li> <li>• Install final 2 screws</li> </ul>						
<b>61</b>	Install Speed Control Knob		Hand				
<b>62</b>	Secure Dipstick Tube (if equipped)	Screw 1x	8mm	10 lb in (1.1Nm)			
<b>FINISHED</b> <b>Get Signature/Initials from Instructor :</b>							