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TORO

Count on it.

Service Manual

1P65F-2 Service Manual

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1P65FC and 1P65FA engine specifications included

8111 Lyndale Avenue South
Bloomington, MN 55420

Original Instructions (EN)
Contact us at www.Toro.com.

Revision History

Preface

This service manual was written expressly for Toro service technicians. The Toro Company has made every effort to make the information in this manual complete and correct.

Basic shop safety knowledge and mechanical/electrical skills are assumed. The Table of Contents lists the systems and the related topics covered in this manual.

We are hopeful that you will find this manual a valuable addition to your service shop. If you have any questions or comments regarding this manual, please contact us at the following address:

The Toro Company

RLC/SWS Customer Care Department

8111 Lyndale Avenue South

Bloomington, MN 55420

The Toro Company reserves the right to change product specifications or make changes to this manual without notice.

Service Procedure Icons

The following icons appear throughout this Service Manual to bring attention to specific important details of a service procedure.

Critical Process

This icon is used to highlight:

- Installing safety equipment (shields, guards, seat belts, brakes, and R.O.P.S. components) that may have been removed
- Dimensions or settings that must be maintained for proper machine operation
- A specific fastener tightening sequence
- Component orientation that may not be obvious

Critical Torque

This icon is used to highlight an assembly torque requirement that is different than what is recommended in the Standard Torque Tables.

Fluid Specifications

This icon is used to highlight fluid specifications and capacities that are less common, and may not appear on the machine service decal or in the machine *Operator's Manual.*

Note: Refer to the service decal on the machine and the machine *Operator's Manual* for commonly used fluid specifications and capacities.

Table of Contents

Chapter 1

Safety

Table of Contents

Safety Instructions

DANGER

This safety symbol means danger. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions could cause serious permanent injury, disability, or death.

WARNING

This safety symbol means warning. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions can result in serious injury.

CAUTION

This safety symbol means caution. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions can result in minor to moderate injury and/or damage to property or equipment.

Think Safety First

Avoid unexpected starting of engine…

Always turn off the engine, remove the ignition key and disconnect the spark plug wire(s) before cleaning, adjusting, or repair.

Avoid lacerations and amputations…

Stay clear of all moving parts whenever the engine is running. Treat all normally moving parts as if they were moving whenever the engine is running or has the potential to start.

Avoid burns…

Do not touch the engine, muffler, or other components, which may be hot during operation, while the unit is running or shortly after it has been running.

Avoid fires and explosions…

Use extreme care in handling fuel. It is flammable and its vapors are explosive. Extinguish all cigarettes, cigars, pipes, and other sources of ignition. Avoid spilling fuel and never smoke while working with any type of fuel or lubricant. Wipe up any spilled fuel or oil immediately. Never remove the fuel cap or add fuel when the engine is running. Always use approved, labeled containers for storing or transporting fuel and lubricants. Do not add or drain fuel in an enclosed space. Do not store the machine or fuel container where there is an open flame, spark, or pilot light, such as on a water heater or other appliance.

Avoid asphyxiation…

Do not operate an engine in a confined area without proper ventilation.

Avoid injury from batteries…

Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing. Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

Avoid injury due to inferior parts…

Use only original equipment parts to ensure that important safety criteria are met.

Avoid injury to bystanders…

Always clear the area of bystanders before starting or testing powered equipment.

Avoid injury due to projectiles…

Always clear the area of sticks, rocks or any other debris that could be picked up and thrown by the powered equipment.

Avoid modifications…

Never alter or modify any part unless it is a factory approved procedure.

Avoid unsafe operation…

Always test the safety interlock system after making adjustments or repairs on the machine. Refer to the Electrical section in this manual for more information.

Avoid electrical shock…

Never touch electrical wires or components while the engine is running. They can be sources of shock. De-energize the system if you are having to do repairs. If testing electrical components ensure you are working in a dry environment.

Hydraulic System...

Release all pressure in the hydraulic system before performing any work on the system. Keep your body and hands away from pin-hole leaks or nozzles that eject hydraulic fluid under high pressure. Do not use your hands to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. Seek medical attention right away if hydraulic fluid gets in the skin.

Personal Protective Equipment…

Use appropriate personal protective equipment (PPE) for protecting yourself from potential hazards in the environment in which you will work. Each process outlined in this manual may need different PPE to protect the service person. Use the proper PPE for the task at hand.

Tools…

All tools should be in proper working order. Do not use tools that are broken or in disrepair. Use the proper tool for the proper application.

Lifts, Hoists, and Jacks…

All lifts, hoists, and jacks should be used in accordance with the manufacturer information. Inspect lifts, hoists, and jacks prior to use. Do not over load lifts, hoists, and jacks. Do not work under a suspended load. Ensure chock blocks are used on equipment that can move. Use lifts or jacks and jack stands that are rated to support the total weight of the machine and any attachments. Do not rely on jacks to support the machine. If you are unsure of the operation of any lifts, hoists, and jacks do not use.

Fire Extinguishers…

The proper class of fire extinguisher should be used in case of fire.

Think Safety First (continued)

Class A extinguishers are for ordinary combustible materials such as paper, wood, cardboard, and most plastics. The numerical rating on these types of extinguishers indicates the amount of water it holds and the amount of fire it can extinguish. Geometric symbol (green triangle).

Class B fires involve flammable or combustible liquids such as gasoline, kerosene, grease and oil. The numerical rating for class B extinguishers indicates the approximate number of square feet of fire it can extinguish. Geometric symbol (red square).

Class C fires involve electrical equipment, such as appliances, wiring, circuit breakers and outlets. Never use water to extinguish class C fires - the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive. Geometric symbol (blue circle).

ABC

fire extinguishers are a dry chemical type used for multiple purposes. See above information for description.

Ensure fire extinguishers are serviceable and replace any that are discharged or out of inspection dates.

Chapter 2

Specifications and Maintenance

Table of Contents

Specifications

1P65F–2 Engine Specifications

Model	1P65F-2
Engine Name	Toro
Type	Single Cylinder 4–stroke, Forced Air Cooled OHV Engine
Bore X Stroke	65 mm x 48 mm
Displacement	159 cc
Compression Ratio	7.6 : 1
Lubrication	Splash
Starting	Recoil/Electric
Rotation	Counter-Clockwise (from PTO Side)
Ignition System	Transistorized Magneto Ignition
Air Cleaner	Foam/Paper
Fuel Type	Unleaded Gasoline 87 Octane 10 % Ethanol
Oil Capacity	18 oz (0.53 L)
Dimension (L x W x H)	15 in. x 13.5 in. x 10 in. (38.10 x 34.29 x 25.40 cm)
Weight	31 lbs. (14.06 kg)
Operating (top) RPM	3000 ± 100 RPM

1P65F–2 Engine Part Specifications

Part	Item	Standard	Service Limit
Cylinder Head	Warpage	N/A	0.004 in. (0.10 mm)
Cylinder	Sleeve (Inside Diameter)	2.559 in. (65 mm)	2.565 in. (65.165 mm)
Piston	Skirt Outside Diameter	2.558 in. (64.985 mm)	2.552 in. (64.845 mm)
	Clearance to Cylinder	0.00059-0.00196 in. (0.015-0.05 mm)	N/A
	Piston Pin Bore Inside Diameter	0.512 in. (13.002 mm)	0.514 in. (13.048 mm)
	Piston - Pin Clearance	0.00008-0.00055 in. (0.002-0.014 mm)	0.00314 in. (0.08 mm)
Piston Pin	Outside Diameter	0.512 in. (13.0 mm)	0.510 in. (12.954 mm)
	Side Clearance (Top/Middle)	0.00056-0.00177 in. (.015-0.045 mm)	0.0059 in. (0.15 mm)
Piston Ring	End Gap (Top/Middle)	0.0078-0.0156 in. (0.2-0.4 mm)	0.040 in. (1.0 mm)
	Width (Top/Middle)	0.0397 in. (1.0 mm)	0.0342 in. (0.87 mm)
	Width (Oil Ring)	0.098 in. (2.5 mm)	0.093 in. (2.37 mm)
Connecting Rod	Small End Inside Diameter	0.513 in. (13.02 mm)	0.515 in. (13.07 mm)
	Big End Inside Diameter	1.024 in. (26.02 mm)	1.026 in. (26.07 mm)
	Large End to Crank Journal Clearance	0.0016-0.0025 in. (0.04-0.063 mm)	0.0047 in. (0.12 mm)
	Large End Side Clearance	0.0039-0.0275 in. (0.1-0.7 mm)	0.0433 in. (1.1 mm)
Crankshaft	Crank Pin Outside Diameter	1.022 in. (25.98 mm)	1.020 in. (25.92 mm)

1P65F–2 Engine Part Specifications (continued)

Part	Item	Standard	Service Limit
Valve	Clearance (Cold) Intake	0.004-0.006 in. (0.10-0.15 mm)	N/A
	Clearance (Cold) Exhaust	0.006-0.008 in. (0.15-0.20 mm)	N/A
	Stem Diameter (Intake)	0.216 in. (5.48 mm)	0.209 in. (5.318 mm)
	Stem Diameter (Exhaust)	0.214 in. (5.44 mm)	0.208 in. (5.275 mm)
Valve Guide	Inside Diameter (Intake, Exhaust)	0.2165 in. (5.50 mm)	0.2193 in. (5.572 mm)
	Stem to Guide Clearance (Intake)	0.00039-0.00133 in. (0.01-0.034 mm)	0.00393 in. (0.10 mm)
	Stem to Guide Clearance (Exhaust)	0.00196-0.00275 in. (0.05-0.070 mm)	0.0047 in. (0.12 mm)
Valve Seat	Seat Width	0.0315 in. (0.8 mm)	0.0787 in. (2.0 mm)
Valve Spring	Free Length	1.202 in. (30.5 mm)	1.141 in. (29.0 mm)
Cam shaft	Height (Intake)	1.091 in. (27.72 mm)	1.080 in. (27.45 mm)
	Height (Exhaust)	1.093 in. (27.78 mm)	1.0826 in. (27.50 mm)
	Outside Diameter (Bearing)	0.550 in. (13.984 mm)	0.547 in. (13.916 mm)
Crankcase Cover	Camshaft Hole Diameter	0.551 in. (14.0 mm)	0.553 in. (14.048 mm)
	Crankshaft Hole Diameter	1.000 in. (25.4 mm)	1.004 in. (25.52 mm)
Spark Plug	Gap	NGK BPR6HS/Champion RL87YC	Gap 0.030 in. (0.7-0.8 mm)
Igniter Coils	Resistance (Primary)	1.3-1.7 ohms	N/A
	Resistance (Secondary)	5.4-6.2 ohms	N/A
	Gap to Flywheel	0.0157 ± 0.007 in. (0.4-0.2 mm)	N/A

1P65F–2 Engine Torque Specifications

Item	Screw Thread	Torque
Cylinder Head Bolt	M8	22-26 ft-lbs. (30-36 Nm)
Connecting Rod Bolt	M7	108-132 in-lbs. (13-15 Nm)
Flywheel Nut	M14 (special nut)	59-66 ft-lbs. (80-90 Nm)
Pivot Adjusting Nut	M5 (special nut)	52-87 in-lbs. (6-10 Nm)
Crankcase Cover Bolt	M6	70-105 in-lbs. (8-12 Nm)
Muffler Nut	M6	70-105 in-lbs. (8-12 Nm)
Air Cleaner Nut	M6	52-87 in-lbs. (6-10 Nm)
Recoil (Fan Cover Nut)	M6	52-87 in-lbs. (6-10 Nm)
Oil Drain Bolt	M10	13-18 ft-lbs. (18-25 Nm)
Fuel Tank Bolt/Nut	M6	13-18 ft-lbs. (18-25 Nm)
Governor Arm Pinch Nut	M6	70-105 in-lbs. (8-12 Nm)
Carburetor Bowl Mount Screw	M8	52–79 ft-lbs. (6-9 Nm)
Fuel Drain Screw	M6	52-79 in-lbs. (6-9 Nm)
Valve Cover Bolt	M6	90 in-lbs. (10 Nm)

1P65F–2 Engine Torque Specifications (continued)

Item	Screw Thread	Torque
Standard Torque Value	M4 bolt	16-26 in-lbs. (2-3 Nm)
	M5 bolt/nut	39-56 in-lbs. (4.5-6.5 Nm)
	M6 bolt/nut	70-105 in-lbs. (8-12 Nm)

1P65FC Engine Specifications

Model	1P65FC
Engine Name	Toro
Type	Single Cylinder 4-Stroke, Forced Air Cooled OHV Engine
Bore X Stroke	65 mm x 48 mm
Displacement	159 cc
Compression Ratio	8 to 1
Lubrication	Splash
Starting	Recoil/Electric
Rotation	Counter-Clockwise (from PTO Side)
Ignition System	Transistorized Magneto Ignition
Air Cleaner	Foam/Paper
Fuel Type	Unleaded Gasoline Minimum 87 Octane 10% Ethanol
Oil Capacity	Max Fill 20 oz (0.59 L)
Dimension (L x W x H)	15 in. x 13.5 in. x 14 in. (38.10 x 24.29 x 35.56 cm)
Weight	26.4 lbs. (11.97 kg)
Operating (Top) RPM	3000 ± 100 RPM

1P65FC Engine Part Specifications

Part	Item	Standard	Service Limit
Cylinder Head	Warpage	N/A	0.004 in. (0.10 mm)
Cylinder	Sleeve Taper/Out of Round (Inside Diameter)	2.559 in. (65 mm)	2.566 in. (65.165 mm)
Piston	Skirt Outside Diameter	2.558 in. (64.985 mm)	2.552 in. (67.845 mm)
	Clearance to Cylinder	0.00059-0.00196 in. (0.015-0.05 mm)	0.0047 in. (0.12 mm)
	Piston Pin Bore Inside Diameter	N/A	0.514 in. (13.048 mm)
	Piston - Pin Clearance	0.00007-0.0005 in. (0.002-0.014 mm)	0.00314 in. (0.08 mm)
Piston Pin	Outside Diameter	0.512 in. (13.0 mm)	0.510 in. (12.954 mm)
	Side Clearance	0.00059-0.00177 in. (.015-0.045 mm)	0.0059 in. (0.15 mm)
Piston Ring	End Gap (Top/Middle)	0.0078-0.0157 in. (0.2-0.4 mm)	0.040 in. (1.0 mm)
	Width (Top/Middle)	0.0393 in. (1.0 mm)	0.0342 in. (0.87 mm)
	Width (Oil Ring)	0.098 in. (2.5 mm)	0.093 in. (2.37 mm)

1P65FC Engine Part Specifications (continued)

Part	Item	Standard	Service Limit
Connecting Rod	Small End Inside Diameter	0.513 in. (13.02 mm)	0.515 in. (13.07 mm)
	Large End Inside Diameter	1.024 in. (26.02 mm)	1.026 in. (26.07 mm)
	Large End to Crank Journal Clearance	0.0016-0.0025 in. (0.04-0.063 mm)	0.0047 in. (0.12 mm)
	Large End Side Clearance	0.0039-0.0275 in. (0.1-0.7 mm)	0.0433 in. (1.1 mm)
Crankshaft	Crank Pin Outside Diameter	1.022 in. (25.98 mm)	1.020 in. (25.92 mm)
Valve	Clearance (Cold) Intake	0.004 in. (0.10 mm)	N/A
	Clearance (Cold) Exhaust	0.006 in. (0.15 mm)	N/A
	Stem Diameter (Intake)	0.216 in. (5.48 mm)	0.209 in. (5.318 mm)
	Stem Diameter (Exhaust)	0.214 in. (5.44 mm)	0.208 in. (5.275 mm)
Valve guide	Inside Diameter (Intake, Exhaust)	0.2165 in. (5.50 mm)	0.2193 in. (5.572 mm)
	Stem to Guide Clearance (Intake)	0.00039-0.00133 in. (0.01-0.034 mm)	0.00393 in. (0.10 mm)
	Stem to Guide Clearance (Exhaust)	0.0019-0.0027 in. (0.05-0.070 mm)	0.0047 in. (0.12 mm)
Valve Seat	Seat Width	0.0314 in. (0.8 mm)	0.0787 in. (2.0 mm)
Valve Spring	Free Length	1.2007 in. (30.5 mm)	1.1417 in. (29.0 mm)
Cam Shaft	Height (Intake)	1.0905 in. (27.72 mm)	1.0807 in. (27.45 mm)
	Height (Exhaust)	1.0937 in. (27.78 mm)	1.0826 in. (27.50 mm)
	Outside Diameter (Bearing)	0.550 in. (13.984 mm)	0.548 in. (13.916 mm)
Crankcase Cover	Camshaft Hole Diameter	0.551 in. (14.0 mm)	0.553 in. (14.048 mm)
	Crankshaft Hole Diameter	1.000 in. (25.4 mm)	1.005 in. (25.52 mm)
Spark Plug	Gap	NGK BPR6HS/Champion RL87YC	Gap 0.030 in. (0.7-0.8 mm)
Igniter Coils	Resistance (Primary)	1.1-1.6 ohms	N/A
	Resistance (Secondary)	10.5 K ohms ± 15%	N/A
	Gap to Flywheel	0.010 in. (0.254 mm)	N/A

1P65FC Engine Torque Specifications

Item	Screw Thread	Torque
Cylinder Head Bolt	M8	25 ft-lbs. (34 Nm)
Connecting Rod Bolt	M7	114 in-lbs (13 Nm)
Flywheel Nut	M14	62 ft-lbs. (85 Nm)
Rocker Arm Adjusting Nut	M6	120 in-lbs. (14 Nm)
Crankcase Cover Bolt	M6	90 in-lbs. (10 Nm)
Muffler Nut	M6	90 in-lbs. (10 Nm)
Air Cleaner Nut	M6	72 in-lbs. (8 Nm)
Recoil (Fan Shroud) Nut	M6	72 in-lbs. (8 Nm)
Oil Drain Bolt	M10	186 in-lbs. (21 Nm)
Fuel Tank Bolt/Nut	M6	90 in-lbs. (10 Nm)

1P65FC Engine Torque Specifications (continued)

Item	Screw Thread	Torque
Fuel Drain Screw	M6	52–79 in-lbs. (6–9 Nm)
Valve Cover Bolt	M6	90 in-lbs. (10 Nm)
Carburetor Mount Screw	M8	52–79 in-lbs. (6–9 Nm)
Spark Plug	N/A	22 ft-lbs. (30 Nm)
Governor Arm Pinch Nut	M6	90 in-lbs. (10 Nm)
Ignition and Charge Coil Bolts	M6	90 in-lbs. (10 Nm)
Electric Starter Motor Bolts	M6	90 in-lbs. (10 Nm)
Standard Torque Value	M5 bolt/nut	54 in-lbs. (6 Nm)
	M6 bolt/nut	90 in-lbs. (10 Nm)
	M8 bolt/nut	228 in-lbs. (26 Nm)
	M10 bolt/nut	28 ft-lbs. (38 Nm)
	M12 bolt/nut	41 ft-lbs. (55 Nm)

1P65FA Engine Specifications

Model	1P65FA
Engine Name	Toro
Type	Single Cylinder 4-Stroke, Forced Air Cooled OHV Engine
Bore X Stroke	65 mm x 48 mm
Displacement	159 cc
Compression Ratio	8 to 1
Lubrication	Splash
Starting	Recoil/Electric
Rotation	Counter-Clockwise (from PTO Side)
Ignition System	Transistorized Magneto Ignition
Air Cleaner	Foam/Paper
Fuel Type	Unleaded Gasoline Minimum 87 Octane 10% Ethanol
Oil Capacity	Max Fill 20 oz (0.59 L)
Dimension (L x W x H)	15 x 13.5 x 14 in. (38.10 x 34.29 x 35.56 cm)
Weight	26.4 lbs. (11.97 kg)
Operating (Top) RPM	3000 ± 100 RPM
Idle speed	2200 ± 150 RPM

1P65FA Engine Part Specifications

Part	Item	Standard	Service Limit
Cylinder Head	Warpage	N/A	0.004 in. (0.10 mm)
Cylinder Out of Round	Sleeve (Inside Diameter)	2.559 in. (65 mm)	2.566 in. (65.165 mm)

1P65FA Engine Part Specifications (continued)

Part	Item	Standard	Service Limit
Piston	Skirt Outside Diameter	2.558 in. (64.985 mm)	2.553 in. (64.845 mm)
	Clearance to Cylinder	0.00059-0.00196 in. (0.015-0.05 mm)	0.0047 in. (0.12 mm)
	Piston Pin Bore Inside Diameter	0.512 in. (13.002 mm)	0.514 in. (13.048 mm)
	Piston - Pin Clearance	0.00007-0.0005 in. (0.002-0.014 mm)	0.00314 in. (0.08 mm)
Piston Pin	Outside Diameter	0.512 in. (13.0 mm)	0.510 in. (12.954 mm)
Piston Ring	End Gap (Top/Middle)	0.0078-0.0156 in. (0.2-0.4 mm)	0.040 in. (1.0 mm)
	Width (Top/Middle)	0.0590 in. (1.5 mm)	0.0539 in. (1.37 mm)
	Width (Oil Ring)	0.098 in. (2.5 mm)	0.093 in. (2.37 mm)
Connecting Rod	Small End Inside Diameter	0.513 in. (13.02 mm)	0.515 in. (13.07 mm)
	Large End Inside Diameter	1.024 in. (26.02 mm)	1.026 in. (26.07 mm)
	Large End to Crank Journal Clearance	0.0016-0.0025 in. (0.04-0.063 mm)	0.0047 in. (0.12 mm)
	Large End Side Clearance	0.0039-0.0275 in. (0.1-0.7 mm)	0.0433 in. (1.1 mm)
Crankshaft	Crank Pin Outside Diameter	1.023 in. (25.98 mm)	1.020 in. (25.92 mm)
Valve	Clearance (Cold) Intake	0.004-0.006 in. (0.10-0.15 mm)	N/A
	Clearance (Cold) Exhaust	0.006-0.008 in. (0.15-0.20 mm)	N/A
	Stem Diameter (Intake)	0.216 in. (5.48 mm)	0.209 in. (5.318 mm)
	Stem Diameter (Exhaust)	0.214 in. (5.44 mm)	0.208 in. (5.275 mm)
Valve Guide	Inside Diameter (Intake, Exhaust)	0.2165 in. (5.50 mm)	0.2193 in. (5.572 mm)
	Stem to Guide Clearance (Intake)	0.00039-0.00133 in. (0.01-0.034 mm)	0.00393 in. (0.10 mm)
	Stem to Guide Clearance (Exhaust)	0.00196-0.00275 in. (0.05-0.070 mm)	0.0047 in. (0.12 mm)
Valve Seat	Seat Width	0.0315 in. (0.8 mm)	0.0787 in. (2.0 mm)
Valve Spring	Free Length	1.200 in. (30.5 mm)	1.142 in. (29.0 mm)
Cam Shaft	Height (Intake)	1.091 in. (27.7 mm)	1.081 in. (27.45 mm)
	Height (Exhaust)	1.093 in. (27.75 mm)	1.0826 in. (27.50 mm)
	Outside Diameter (Bearing)	0.550 in. (13.984 mm)	0.548 in. (13.916 mm)
Crankcase Cover	Camshaft Hole Diameter	0.551 in. (14.0 mm)	0.553 in. (14.048 mm)
	Crankshaft Hole Diameter	1.000 in. (25.4 mm)	1.005 in. (25.52 mm)
Spark Plug	Gap	NGK BPR6HS/Champion RL87YC	Gap 0.030 in. (0.7-0.8 mm)
Igniter Coils	Resistance (Primary)	1.1-1.6 ohms	N/A
	Resistance (Secondary)	10.5 K ohms ± 15%	N/A
	Gap to Flywheel	0.010 in. (0.254 mm)	N/A

1P65FA Engine Torque Specifications

1P65FA Engine Torque Specifications (continued)

Item	Screw Thread	Torque
Cylinder Head Bolt	M8	25 ft-lbs. (34 Nm)
Connecting Rod Bolt	M7	114 in-lbs. (13 Nm)
Flywheel Nut	M14	62 ft-lbs. (85 Nm)
Rocker Arm Pivot Stud	M8	22 ft-lbs. (30 Nm)
Rocker Arm Lock Nut	M6	120 in-lbs (14 Nm)
Crankcase Cover Bolt	M6	90 in-lbs. (10 Nm)
Muffler Nuts	M6	90 in-lbs. (10 Nm)
Air Cleaner Nuts	M6	72 in-lbs. (8 Nm)
Recoil (Fan Cover Nut)	M6	72 in-lbs. (8 Nm)
Oil Drain Bolt	M10	180 in-lbs. (21 Nm)
Fuel Tank Bolt/Nut	M6	90 in-lbs. (10 Nm)
Fuel Drain Screw	M6	52–79 in-lbs. (6–9 Nm)
Valve Cover bolt	M6	90 in-lbs. (10 Nm)
Carburetor Bowl Mount Screw	M8	52–79 in-lbs. (6–9 Nm)
Spark Plug	N/A	22 ft-lbs. (30 Nm)
Governor Arm Pinch Nut	M6	90 in-lbs. (10 Nm)
Ignition and Charge Coil Bolts	M6	90 in-lbs. (10 Nm)
Electric Starter Motor Bolts	M6	90 in-lbs. (10 Nm)
Standard Torque Value	M5 bolt/nut	54 in-lbs. (6 Nm)
	M6 bolt/nut	90 in-lbs. (10 Nm)
	M8 bolt/nut	228 in-lbs. (26 Nm)
	M10 bolt/nut	28 ft-lbs. (38 Nm)
	M12 bolt/nut	41 ft-lbs. (55 Nm)

Torque Specifications

The recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in the service manual.

These torque specifications for the installation and tightening of fasteners shall apply for all fasteners which do not have a specific requirement identified in the service manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature, hardness of the surface underneath of the fastener's head, or similar condition which affects the installation.

As noted in the following tables, torque values should be reduced by 25% for lubricated fasteners to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification

Inch Series Bolts and Screws

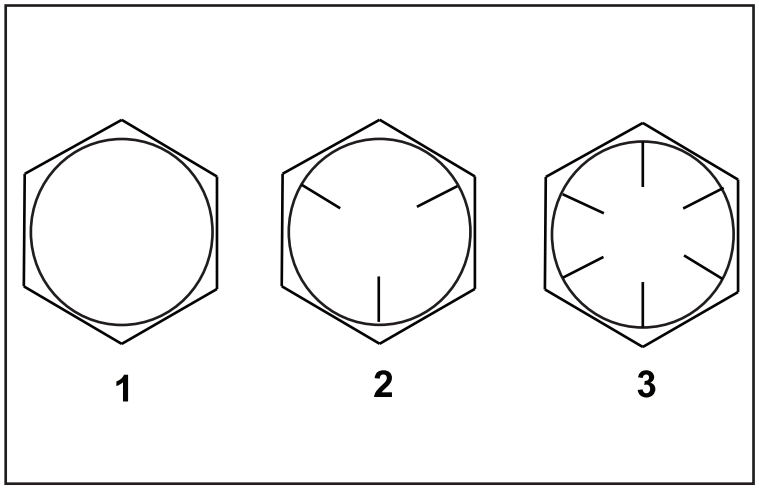

Figure 1

1. Grade 1
2. Grade 5
3. Grade 8

Metric Bolts and Screws

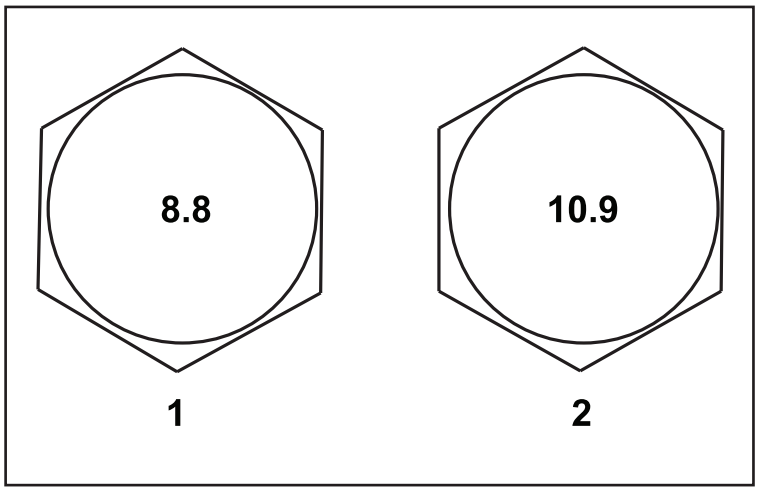

Figure 2

1. Class 8.8
2. Class 10.9

Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Inch Series)

Thread Size	Grade 1, 5, & 8 Fasteners with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE Grade 2 or Better Nut)		SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE Grade 5 or Better Nut)		SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE Grade 8 or Better Nut)	
	In-lb.	In-lb.	N-cm	In-lb.	N-cm	In-lb.	N-cm
#6-32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	169 ± 23	23 ± 3	260 ± 34
#6-40 UNF				17 ± 2	192 ± 23	25 ± 3	282 ± 34
#8-32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	328 ± 34	41 ± 5	463 ± 56
#8-36 UNF				31 ± 4	350 ± 45	43 ± 5	486 ± 56
#10-24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 5	475 ± 56	60 ± 6	678 ± 68
#10-32 UNF				48 ± 5	542 ± 56	68 ± 7	768 ± 79
1/4-20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1130 ± 113	140 ± 15	1582 ± 169
1/4-28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 12	1299 ± 136	160 ± 17	1808 ± 192
5/16-18 UNC	115 ± 15	105 ± 15	1186 ± 169	200 ± 25	2260 ± 282	300 ± 30	3390 ± 339
5/16-24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2542 ± 282	325 ± 33	3672 ± 373
	ft-lb.	ft-lb.	N-m	ft-lb.	N-m	ft-lb.	N-m
3/8-16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 5	58 ± 7
3/8-24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 4	47 ± 5	50 ± 6	68 ± 8
7/16-14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16-20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 6	75 ± 8	77 ± 8	104 ± 11
1/2-13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 11	142 ± 15
1/2-20 UNF	32 ± 4	53 ± 7	72 ± 9	85 ± 9	115 ± 12	120 ± 12	163 ± 16
5/8-11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 21	285 ± 28
5/8-18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 18	230 ± 24	240 ± 24	325 ± 33
3/4-10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 27	359 ± 37	375 ± 38	508 ± 52
3/4-16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 30	407 ± 41	420 ± 43	569 ± 58
7/8-9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8-14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 48	644 ± 65	667 ± 66	904 ± 89

Note: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite, or thread sealant such as Loctite.

Torque values my have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin nuts include jam nuts.

Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Series)

Thread Size	Class 8.8 Bolts, Screws, Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws, Studs with Regular Height Nuts (Class 10 or stronger Nuts)	
	in-lb.	N-cm	in-lb.	N-cm
M5 X 0.8	57 ± 6	644 ± 68	78 ± 8	881 ± 90
M6 X 1.0	96 ± 10	1085 ± 113	133 ± 14	1503 ± 158
	ft-lbs.	**N-m**	**ft-lbs.**	**N-m**
M8 X 1.25	19 ± 2	26 ± 3	28 ± 3	38 ± 4
M10 X 1.5	38 ± 4	52 ± 5	54 ± 6	73 ± 8
M12 X 1.75	66 ± 7	90 ± 10	93 ± 10	126 ± 14
M16 X 2.0	166 ± 17	255 ± 23	229 ± 23	310 ± 31
M20 X 2.5	325 ± 33	440 ± 45	450 ± 46	610 ± 62

Note: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite, or thread sealant such as Loctite.

Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

SAE Grade 8 Steel Set Screws

Thread Size	Recommended Torque	
	Square Head	Hex Socket
1/4 - 20 UNC	140 ± 20 in-lb.	73 ± 12 in-lb.
5/16 - 18 UNC	215 ± 35 in-lb.	145 ± 20 in-lb.
1/2 - 13 UNC	75 ± 15 ft-lb.	50 ± 10 ft-lb.
3/8 - 16 UNC	35 ± 10 ft-lb.	18 ± 3 ft-lb.

Wheel Bolts and Lug Nuts

Thread Size	Recommended Torque**	
7/16 - 20 UNF Grade 5	65 ± 10 ft-lb.	88 ± 14 N-m
1/2 - 20 UNF Grade 5	80 ± 10 ft-lb.	108 ± 14 N-m
M12 X 1.25 Class 8.8	80 ± 10 ft-lb.	108 ± 14 Nm
M12 X 1.5 Class 8.8	80 ± 10 ft-lb.	108 ± 14 Nm

**For steel wheels and non-lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

Type 1, Type 23, or Type F	
Thread Size	**Baseline Torque***
No. 6 - 32 UNC	20 ± 5 in-lb.
No. 8 - 32 UNC	30 ± 5 in-lb.
No. 10 - 24 UNC	38 ± 7 in-lb.
1/4 - 20 UNC	85 ± 15 in-lb.
5/16 - 18 UNC	110 ± 20 in-lb.
3/8 - 16 UNC	200 ± 100 in-lb.

*Hole size, material strength, material thickness and finish must be considered when determining specific torque values. All torque values are based on non-lubricated fasteners.

Conversion Factors

in-lb. X 11.2985 = N-cm

ft-lb. X 1.3558 = N-m

N-cm X 0.08851 = in-lb.

N-cm X 0.73776 = ft-lb.

Thread Cutting Screws (Zinc Plated Steel)

Threads Size	Threads per Inch		Baseline Torque*
	Type A	Type B	
No. 6	18	20	20 ± 5 in-lb.
No. 8	15	18	30 ± 5 in-lb.
No. 10	12	16	38 ± 7 in-lb.
No. 12	11	14	85 ± 15 in-lb.

*Hole size, material strength, material thickness and finish must be considered when determining specific torque values. All torque values are based on non-lubricated fasteners.

Equivalents and Conversions

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm
1/64	0.015625	0.397	**33/64**	0.515625	13.097
1/32	0.03125	0.794	**16/32**	0.53125	13.484
3/64	0.046875	1.191	**35/64**	0.546875	13.891
1/16	0.0625	1.588	**9/16**	0.5625	14.288
5/64	0.078125	1.984	**37/64**	0.578125	14.684
3/32	0.9375	2.381	**19/32**	0.59375	15.081
1/8	0.1250	3.175	**5/8**	0.6250	15.875
9/64	0.140625	3.572	**41/64**	0.640625	16.272
5/32	0.15625	3.969	**21/32**	0.65625	16.669
11/64	0.171875	4.366	**43/64**	0.671875	17.066
3/16	0.1875	4.762	**11/64**	0.6875	17.462
13/64	0.203125	5.159	**45/64**	0.703125	17.859
7/32	0.21875	5.556	**23/32**	0.71875	18.256
15/64	0.234375	5.953	**47/64**	0.734375	18.653
1/4	0.2500	6.350	**3/4**	0.7500	19.050
17/64	0.265625	6.747	**49/64**	0.765625	19.447
9/32	0.28125	7.144	**25/32**	0.78125	19.844
19/64	0.296875	7.541	**51/64**	0.796875	20.241
5/16	0.3125	7.541	**13/16**	0.8125	20.638
21/64	0.328125	8.334	**53/64**	0.828125	21.034
11/32	0.34375	8.731	**27/32**	0.84375	21.431
23/64	0.359375	9.128	**55/64**	0.859375	21.828
3/8	0.3750	9.525	**7/8**	0.8750	22.225
25/64	0.390625	9.922	**57/64**	0.890625	22.622
13/32	0.40625	10.319	**29/32**	0.90625	23.019
27/64	0.421875	10.716	**59/64**	0.921875	23.416
7/16	0.4375	11.112	**15/16**	0.9375	23.812
29/64	0.453125	11.509	**61/64**	0.953125	24.209
15/32	0.46875	11.906	**31/32**	0.96875	24.606
31/64	0.484375	12.303	**63/64**	0.984375	25.003
1/2	0.5000	12.700	**1**	1.000	25.400
1 mm = 0.03937 in.			**0.001 in. = 0.0254 mm**		

U.S. to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces	Grams	28.3495
Pressure	Pounds/Square Inch	Kilopascal	6.895
Work	Foot-Pounds	Newton-Meters	1.356
	Foot-Pounds	Kilogram-Meters	0.1383
	Inch-Pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flows	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract by 32°
			2. Multiply by 5/9

Table of Contents

GEARS

The Systematic approach to defining, diagnosing and solving problems.

G

Gather Information

- Information reported by the customer
- Information observed by you
- Establish the what, where and when of the issue

E

Evaluate Potential Causes

- Consider possible causes of the problem to develop a hypothesis
- Narrow down the focus of the problem

A

Assess Performance

- Ensure you have all the necessary tools for testing
- Test all potential causes of the failure
- Reevaluate and create new hypotheses if necessary

R

Repair

- Return the unit to service by repairing, rebuilding or replacing

S

Solution Confirmation

- Did the issue go away
- Was the root cause of the issue correctly repaired
- Are there any other new symptoms

General Troubleshooting

Problem	Possible Cause	Corrective Action
Engine turns over but will not start	Choke not closed	1. Check to see if the choke is fully closed at start up. 2. Check the thermal control, choke linkage, and air vane operation. 3. Make adjustments or replace components as necessary.
	Fuel delivery issue	1. Check fuel level in the tank, fuel filter, fuel lines, fuel tank venting, and carburetor. 2. Clean debris from the fuel system. 3. Replace damaged components as necessary.
	Fuel quality	1. Check the fuel condition for age, octane, ethanol, percentage, water or other contaminates. 2. Flush the fuel system. 3. Replace the fuel.
	Weak or no spark	1. Check to verify the spark plug cap is installed correctly, ignition coil air gap, spark plug, and spark plug gap. 2. Adjust the ignition coil air gap. 3. Replace damaged components.
	Insufficient compression	1. Perform a leak down test. 2. Check for worn cylinder, valve(s) not seating, valve clearance, and head gasket. 3. Adjust the valve clearance. 4. Replace damaged components.

General Troubleshooting (continued)

Problem	Possible Cause	Corrective Action
Engine hard starting/poor running	Fuel quality	1. Check the fuel condition for age, octane, ethanol, percentage, water or other contaminates. 2. Flush the fuel system and fuel.
	Fuel delivery issue	1. Check the fuel level in the tank, fuel filter, fuel lines, fuel tank venting, and carburetor. 2. Clean debris from the fuel system. 3. Replace as necessary
	Spark plug	1. Check to verify the correct spark plug is used and correct gap. 2. Verify spark plug operation. 3. Replace as necessary.
	Air filter	1. Check to verify the air filter isn't clogged or damaged. 2. Replace as necessary.
	Ignition coil	1. Perform a spark test 2. Check the ignition coil air gap. 3. Adjust ignition coil air gap or replace coil as necessary.
	Choke function	1. Check the choke is closing on start-up and opening after the engine is running. 2. Check the thermal control, choke linkage, and air vane operation. 3. Make adjustments or replace components as necessary.
	Insufficient compression	1. Perform a leak down test 2. Check the valve clearance, valves not seating, worn cylinder, and head gasket leaking. 3. Adjust the valve clearance. 4. Replace damaged components.

General Troubleshooting (continued)

Problem	Possible Cause	Corrective Action
Engine doesn't crank	Electrical issues	1. Check the battery voltage, electrical connections, and the voltage to the starter motor. 2. Replace damaged components.
	Starter motor	1. Bench test the starter motor. 2. Replace as necessary.
Engine overheats	Cylinder Cooling fins	1. Check for debris build-up under the engine shroud. 2. Clean debris from the cooling fins.
	Oil	1. Check the oil level, oil condition, and correct oil viscosity. 2. Change the oil using the correct viscosity.
	Engine gasket leaking	1. Check the head gasket for leaking. 2. Check for warped cylinder head. 3. Replace head gasket as necessary.

Chapter 4

Engine Top End

Table of Contents

General Information

This chapter covers the disassembly, inspection, and reassembly of the recoil, flywheel, and crankcase breather assemblies.

Service and Repairs

Engine Top End Assembly 1

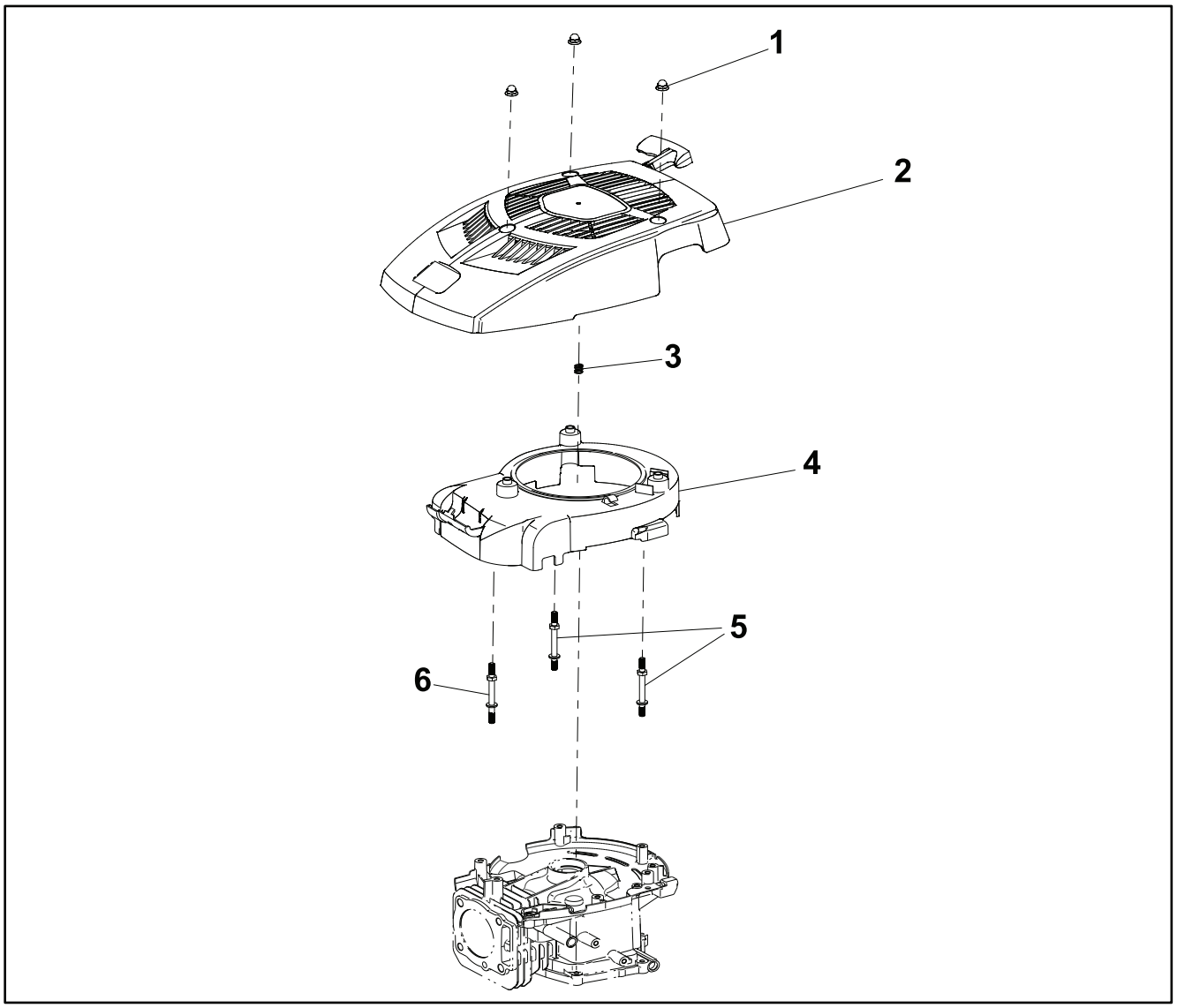

Figure 3

1. Acorn Nut
2. Recoil Shroud Asm.
3. Recoil Compression Spring
4. Fan Shroud
5. Shroud Stud 3.42 inch (86.9 mm)
6. Shroud Stud 3.31 inch (84.0 mm)

Engine Top End Assembly 2

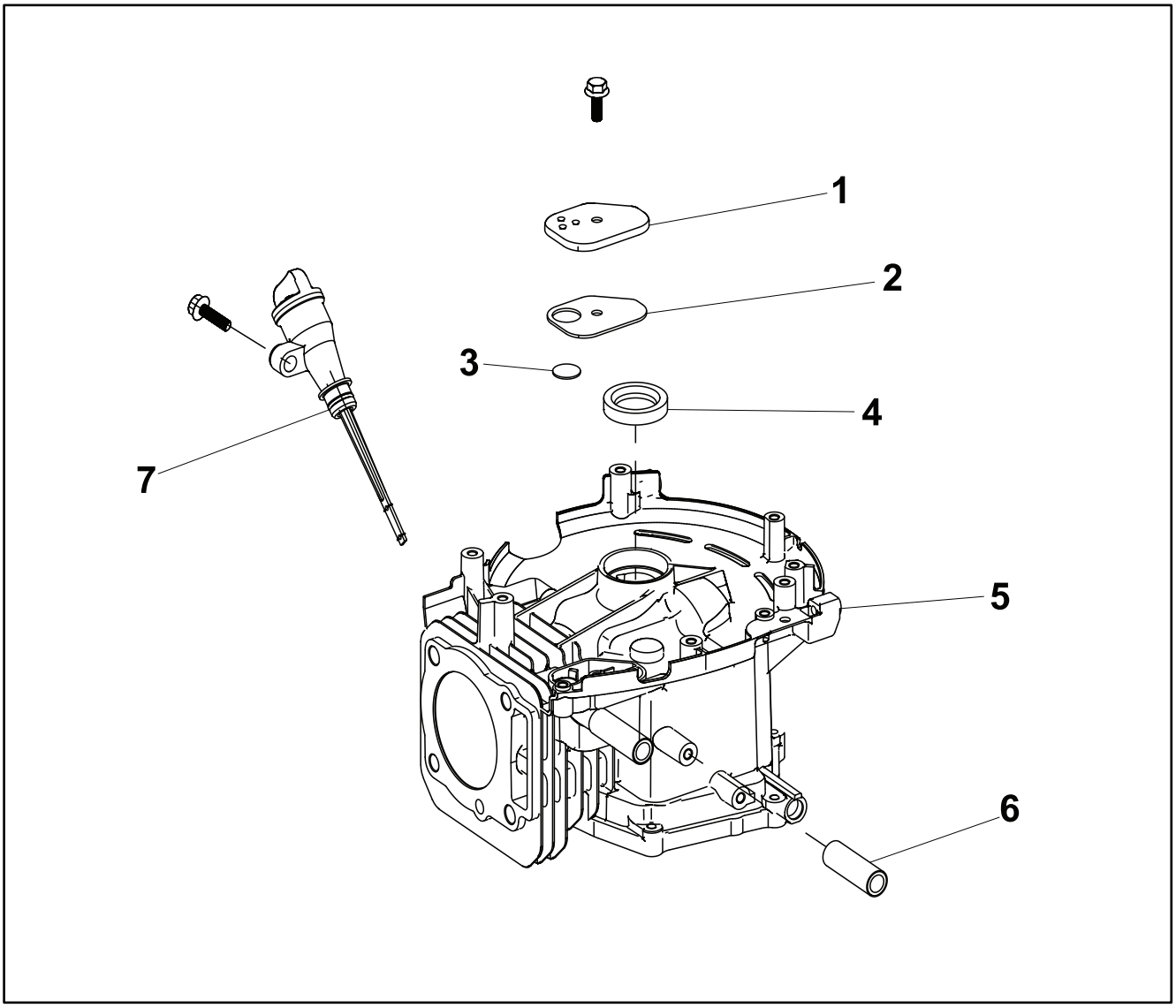

Figure 4

1. Breather Cover
2. Breather Gasket Cover
3. Breather Valve
4. Oil Seal
5. Crankcase
6. Breather Tube
7. Dipstick and Fill Tube Kit

Engine Top End Assembly 3

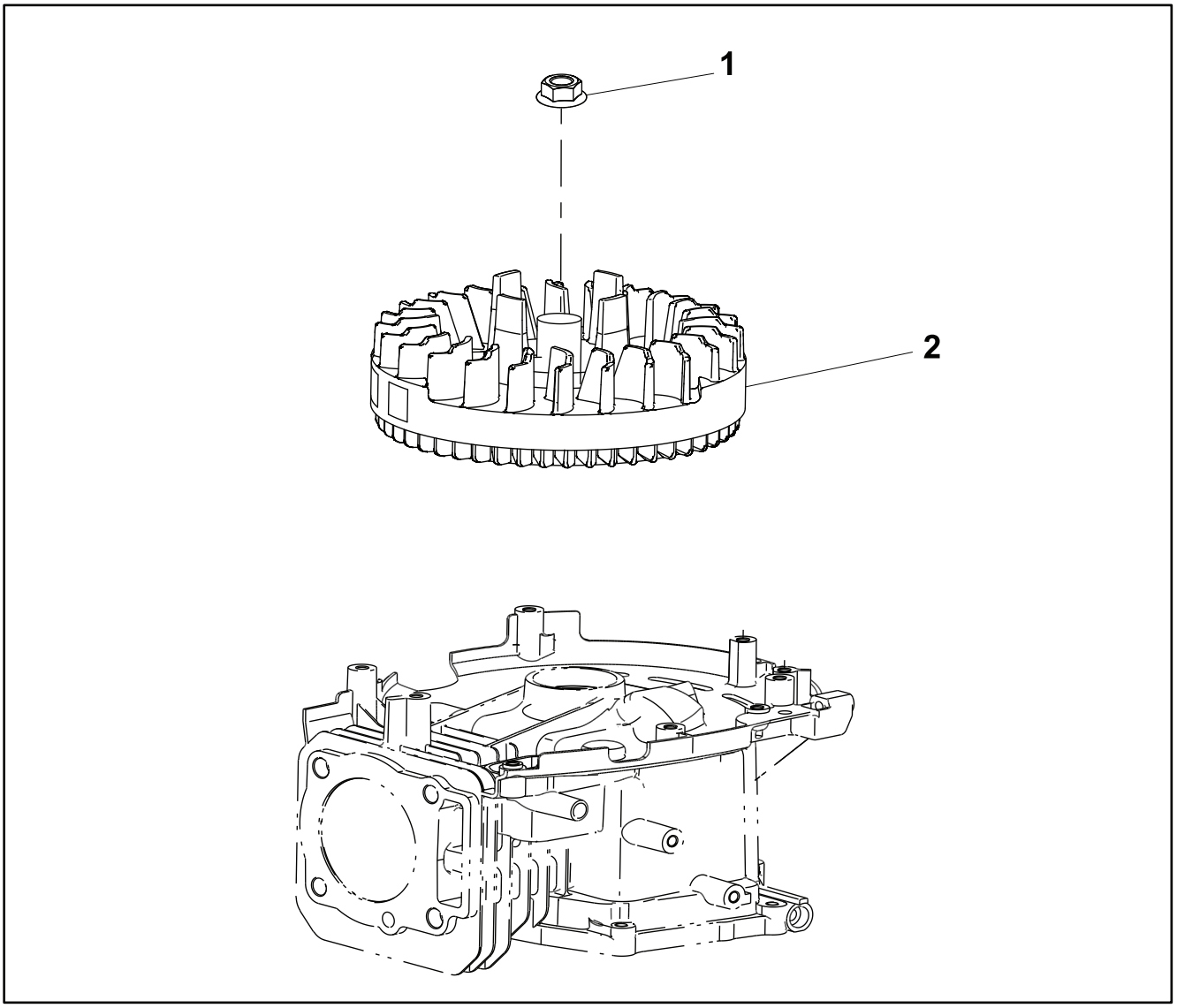

Figure 5

1. Flange Nut
2. Flywheel

Recoil Replacement

Recoil Removal

1. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 6

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2. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

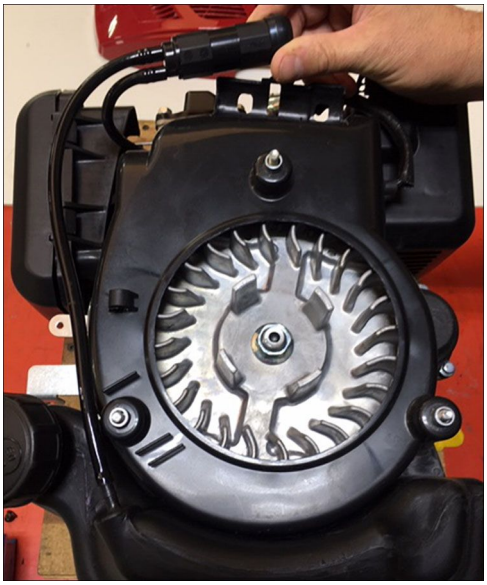

Figure 7

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3. Remove the shroud by lifting away from the engine.

Recoil Inspection

1. Check the recoil dogs for excessive wear.

Recoil Inspection (continued)

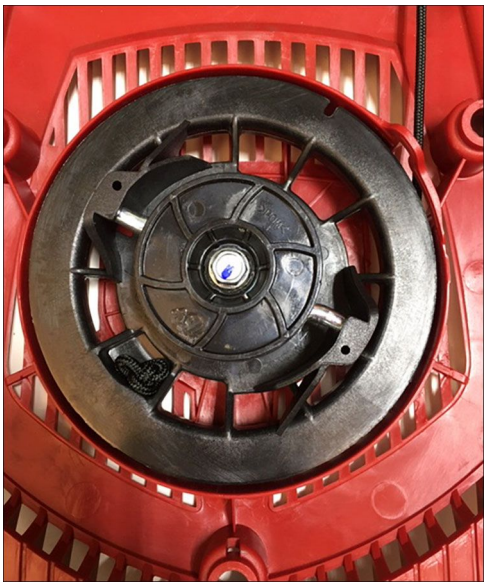

Figure 8

2. Verify the recoil dogs fully engage and disengage (fully seated) with the recoil hub.

Recoil Installation

1. Install the shroud onto the engine.
2. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

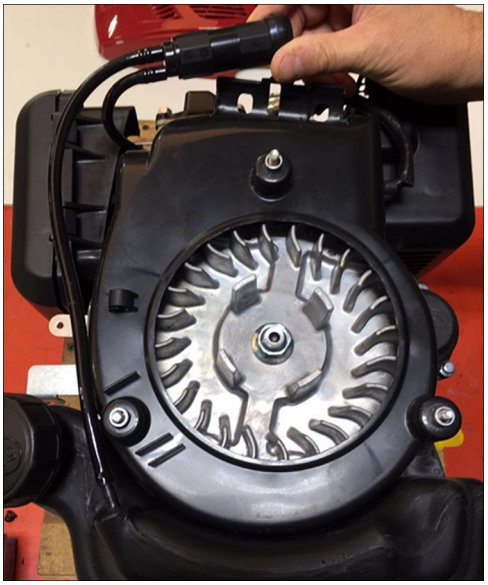

Figure 9

3. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52—87 in-lbs. (6–10 Nm).

Figure 10

Flywheel Replacement

Flywheel Removal

1. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 11

2. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

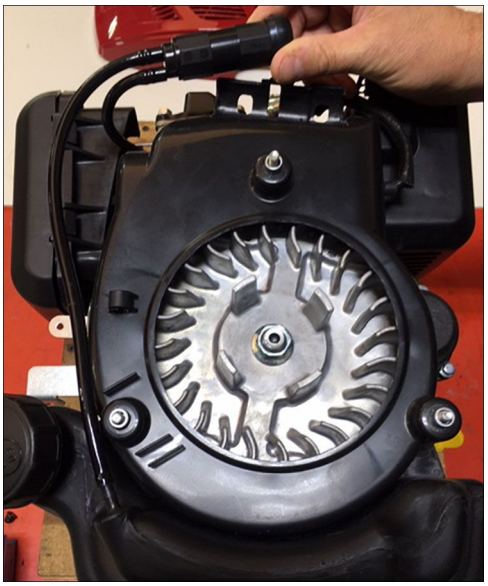

Figure 12

3. Remove the shroud by lifting away from the engine.
4. Loosen the nut securing the crankshaft to the engine.
5. Unhook the spring from the brake mechanism.

Figure 13

6. Place a pry bar under the flywheel to pry the flywheel upwards. Use a soft based hammer, loosen the flywheel assembly from the crankshaft, only striking the top of the nut to prevent crankshaft damage.

Flywheel Removal (continued)

Figure 14

7. Remove the nut from the crankshaft. Remove the flywheel from the engine.

Figure 15

Flywheel Inspection

Inspect the keyway for damage.

Flywheel Inspection (continued)

Figure 16

Flywheel Installation

1. Install the flywheel onto the crankcase.

Figure 17

2. Install the nut securing the flywheel to the crankshaft. Torque nut to 59–66 ft-lbs. (80–90 Nm).

3. Hook the spring to the brake mechanism.

Figure 18

4. Install the shroud onto the engine.
5. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

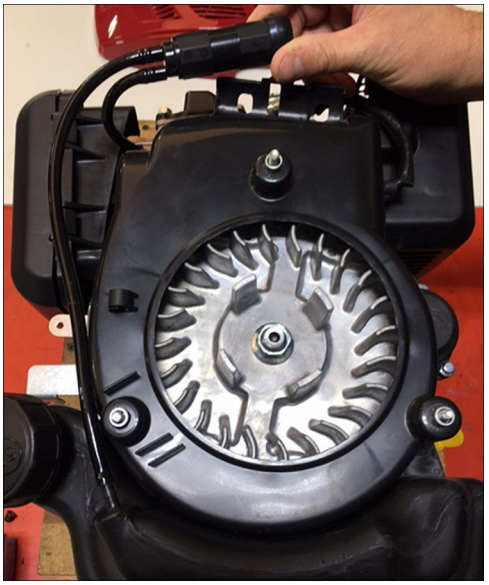

Figure 19

6. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 in-lbs. (6–10 Nm).

Figure 20

Crankcase Breather System Replacement

Crankcase Breather System Removal

1. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 21

2. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

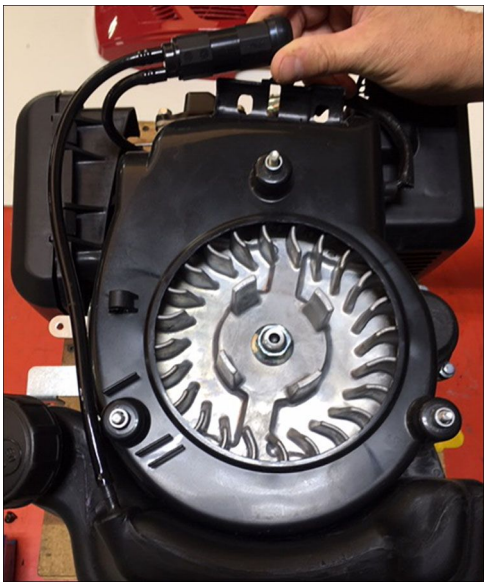

Figure 22

3. Remove the shroud by lifting away from the engine.
4. Loosen the nut securing the crankshaft to the engine.
5. Unhook the spring from the brake mechanism.

Figure 23

6. Place a pry bar under the flywheel, pry the flywheel upwards. Using a soft based hammer, loosen the flywheel assembly from crankshaft, only striking the top of the nut to prevent crankshaft damage.

Figure 24

7. Remove the nut from the crankshaft. Remove the flywheel from the engine.

Figure 25

8. Remove the ground wire from the brake assembly.

Figure 26

9. Remove the 2 wires leading to the brake switch.

Figure 27

10. Remove the 2 bolts securing the brake assembly to the crankcase.

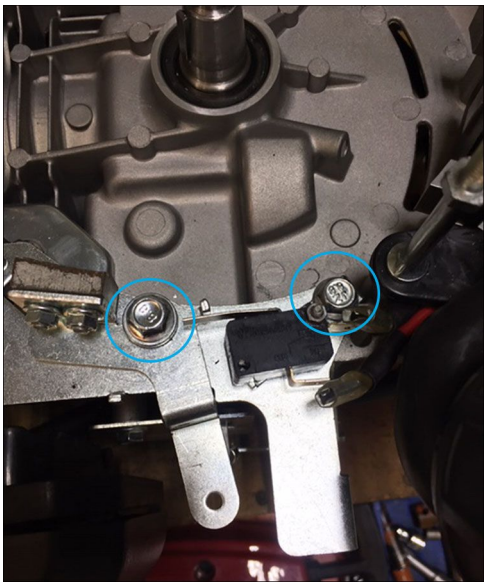

Figure 28

11. Remove the bolt securing the breather assembly to the cover.

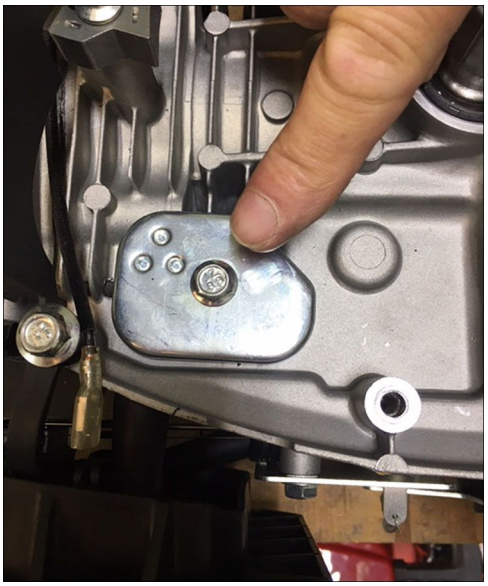

Figure 29

12. Remove the cover from the breather assembly.

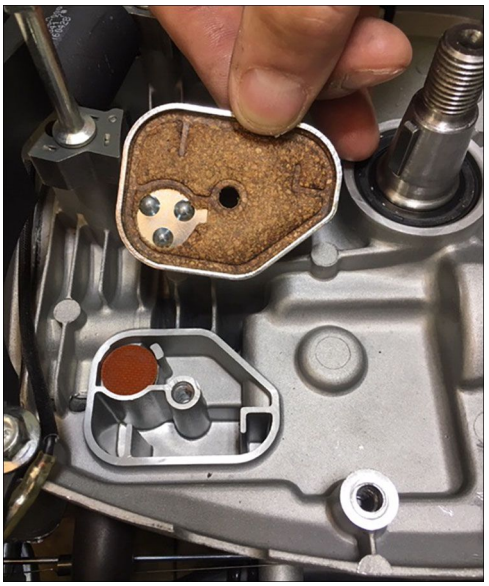

Figure 30

13. Remove the valve from the breather assembly.

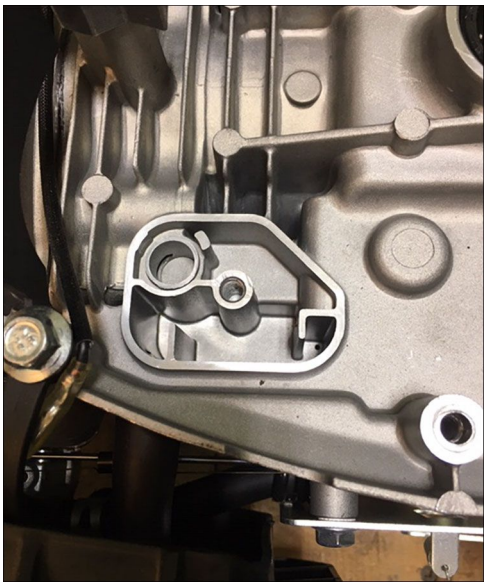

Figure 31

Crankcase Breather System Inspection

1. Inspect the valve seating surface for damage.

Figure 32

2. Inspect the face of the valve for wear or damage.

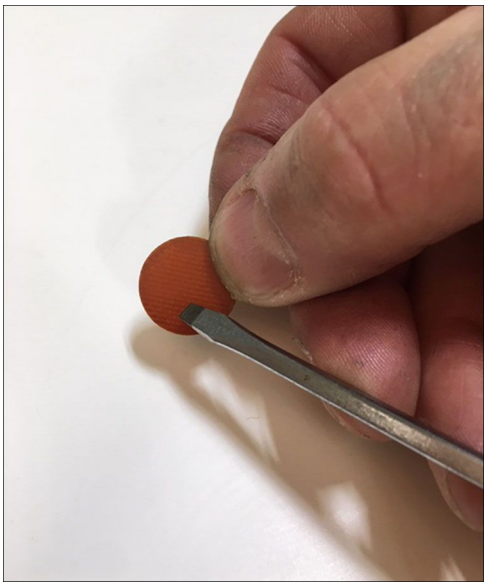

Figure 33

Crankcase Breather System Installation

1. Install the valve onto the breather assembly.

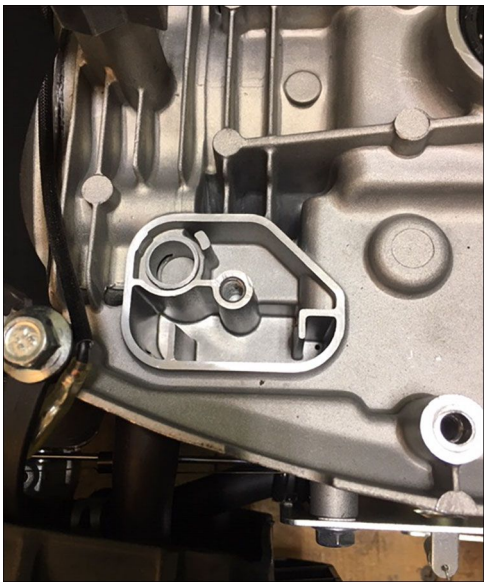

Figure 34

2. Install the cover to the breather assembly. Secure with a 10 mm bolt. Torque bolt to 90 in-lbs. (10 Nm).

Figure 35

3. Install the 2 (10 mm) bolts securing the brake assembly to the crankcase. Torque bolts to 90 in-lbs. (10 Nm).

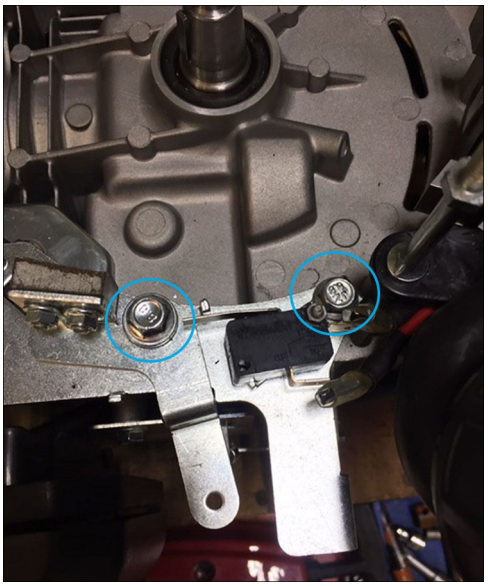

Figure 36

4. Install the 2 wires leading to the brake switch assembly.

Figure 37

5. Install the ground wire to the brake assembly.

Figure 38

6. Install the flywheel onto the engine.

Figure 39

7. Install the nut securing the flywheel to the crankshaft. Torque nut to 59–66 ft-lbs. (80–90 Nm).

8. Hook the spring to the brake mechanism.

Figure 40

9. Install the shroud onto the engine.
10. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

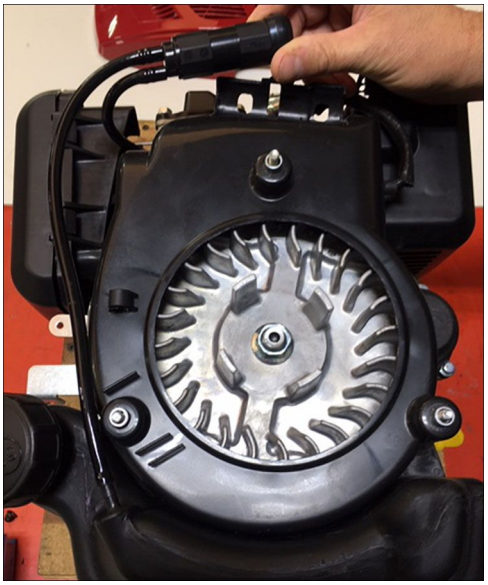

Figure 41

11. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 in-lbs. (6–10 Nm).

Figure 42

Chapter 5

Air Intake System

Table of Contents

General Information

The Toro 1P65F-2 engine is equipped with a 2–stage filtration system. This chapter covers the disassembly, inspection, and assembly of the air intake system.

Service and Repairs

Air Intake System Assembly

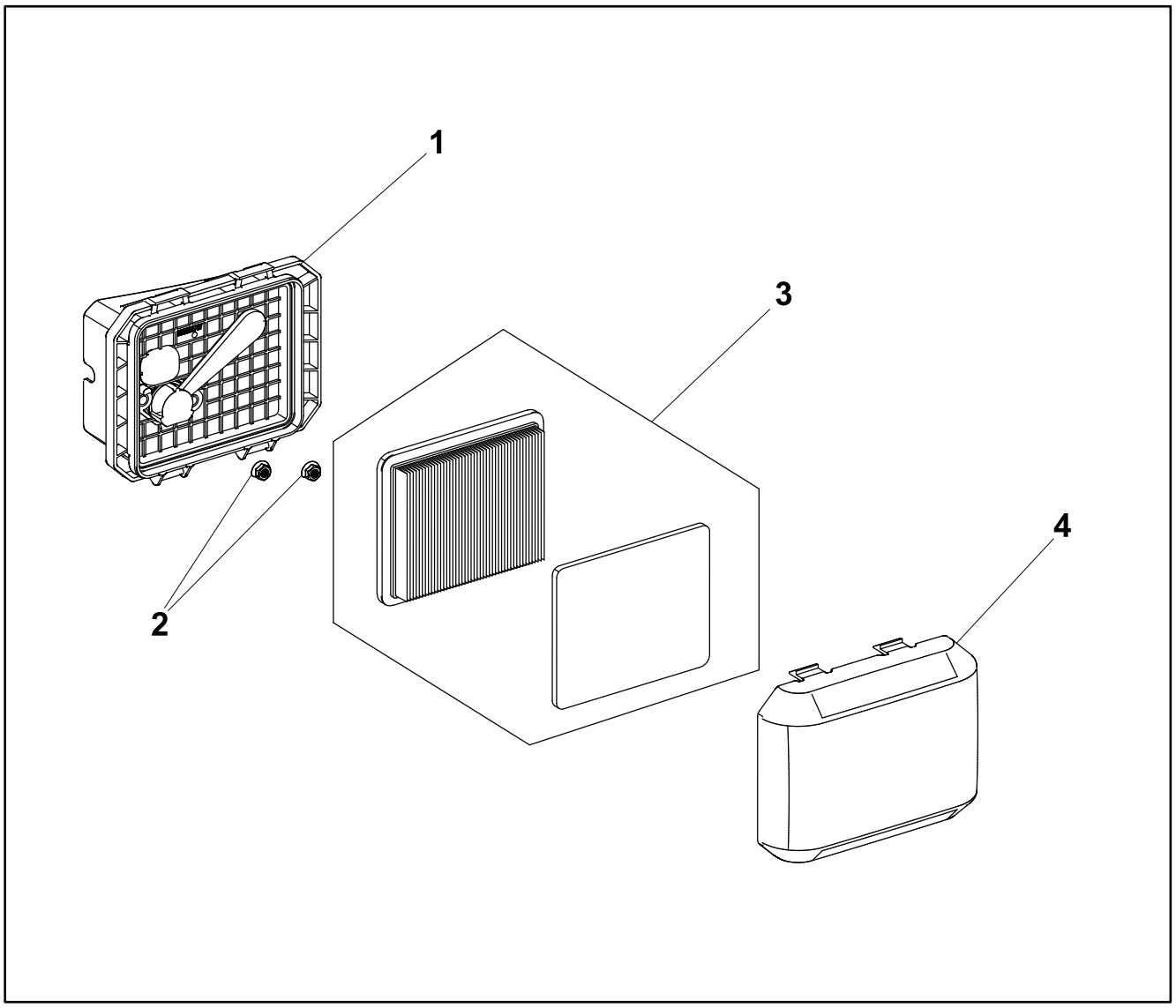

Figure 43

1. Air Cleaner Base
2. Flange Nut
3. Air Filter and Prefilter Kit
4. Air Cleaner Cover

Air Filter Replacement

Air Filter Removal

1. Push down on the 2 air filter cover latch tabs.

Figure 44

---

2. Hinge the air filter cover downward. Remove the cover from the air filter housing assembly.
3. Remove the air filter from the air filter housing.

Air Filter Inspection

1. Check the air filter for damage or excessive dirt and debris.

Figure 45

---

2. Remove the foam pre-filter from the air filter cover. Check for damage or excessive dirt and debris.

Air Filter Inspection (continued)

Figure 46

Air Filter Installation

1. Install the air filter into the air filter housing.

Figure 47

---

2. Install the cover to the air filter housing assembly.
3. Hinge the air filter cover upward and lock into place.

Air Box Replacement

Air Box Removal

1. Push down on the 2 air filter cover latch tabs.

Figure 48

2. Hinge the air filter cover downward. Remove the cover from the air filter housing assembly.
3. Remove the air filter from the air filter housing.
4. Remove the 2 (10 mm) nuts securing the air filter housing to the engine.

Figure 49

5. Remove the air filter housing from the engine.

Air Box Inspection

Inspect the O-ring on the back side (carburetor side) of the air filter housing for damage.

Air Box Inspection (continued)

Figure 50

Air Box Installation

1. Install the air filter housing to the engine. Secure with 2 (10 mm) nuts securing the air filter housing to the engine. Torque nuts to 52–87 in-lbs. (6–10 Nm).

Figure 51

2. Install the air filter into the air filter housing.

Figure 52

3. Install the cover to the air filter housing assembly.
4. Hinge the air filter cover upward and lock into place

Chapter 6

Fuel System

Table of Contents

General Information

This chapter covers the disassembly, inspection, and assembly of the fuel system. The fuel system consists of a sealed fuel tank that is vented to the carburetor manifold through a carbon canister. The fuel is gravity fed to the carburetor through an in-line fuel filter to the carburetor float bowl. The fuel flow is controlled by the movement of the float inside the float bowl as the fuel level rises and falls.

Service and Repairs

Fuel System Assembly 1

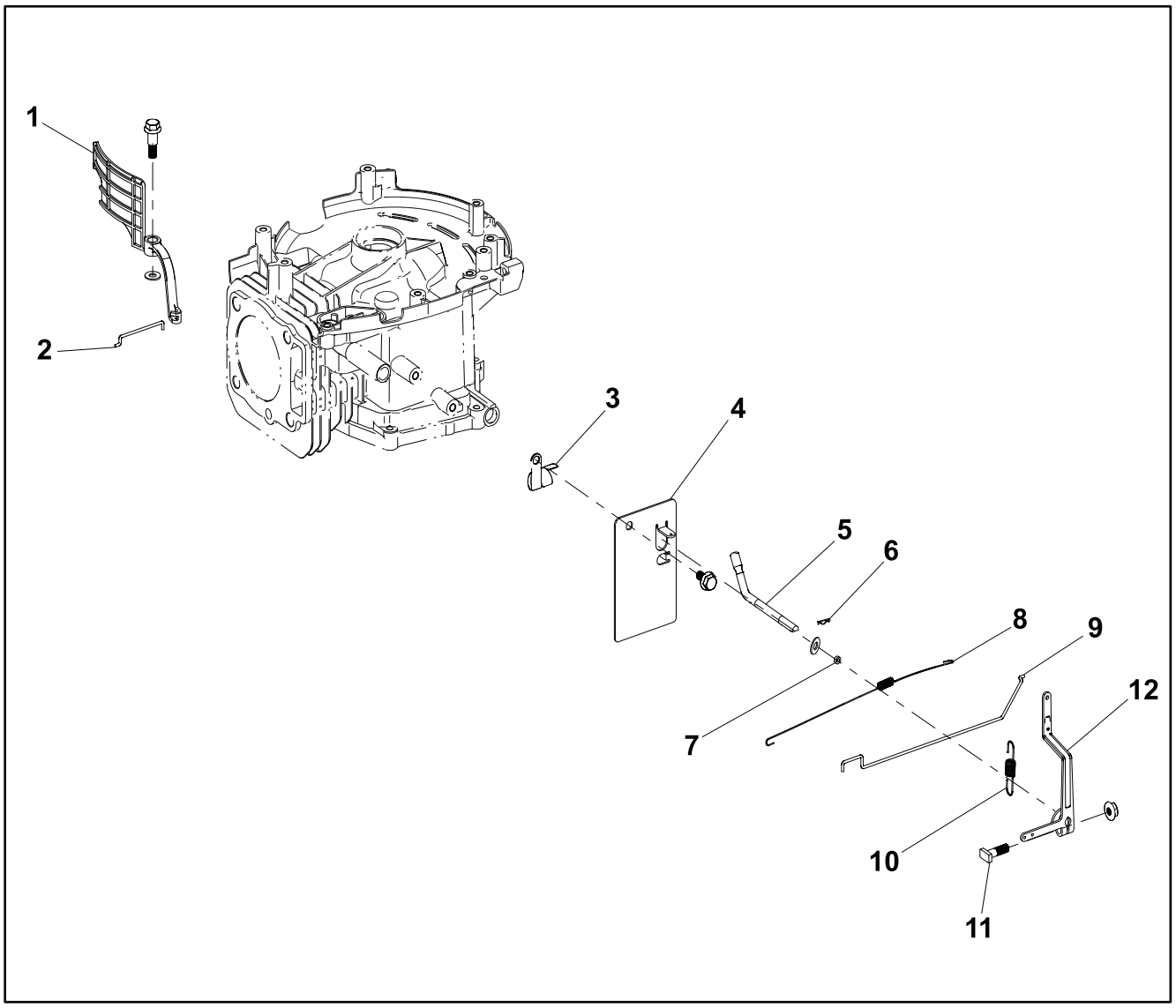

Figure 53

1. Auto Choke Air Vane
2. Choke Linkage
3. Wire Harness Clip
4. Throttle Control Plate
5. Governor Arm
6. Hair Pin
7. Oil Seal
8. Throttle Return Spring
9. Governor Rod
10. Governor Spring
11. Governor Arm Bolt
12. Governor Arm

Fuel System Assembly 2

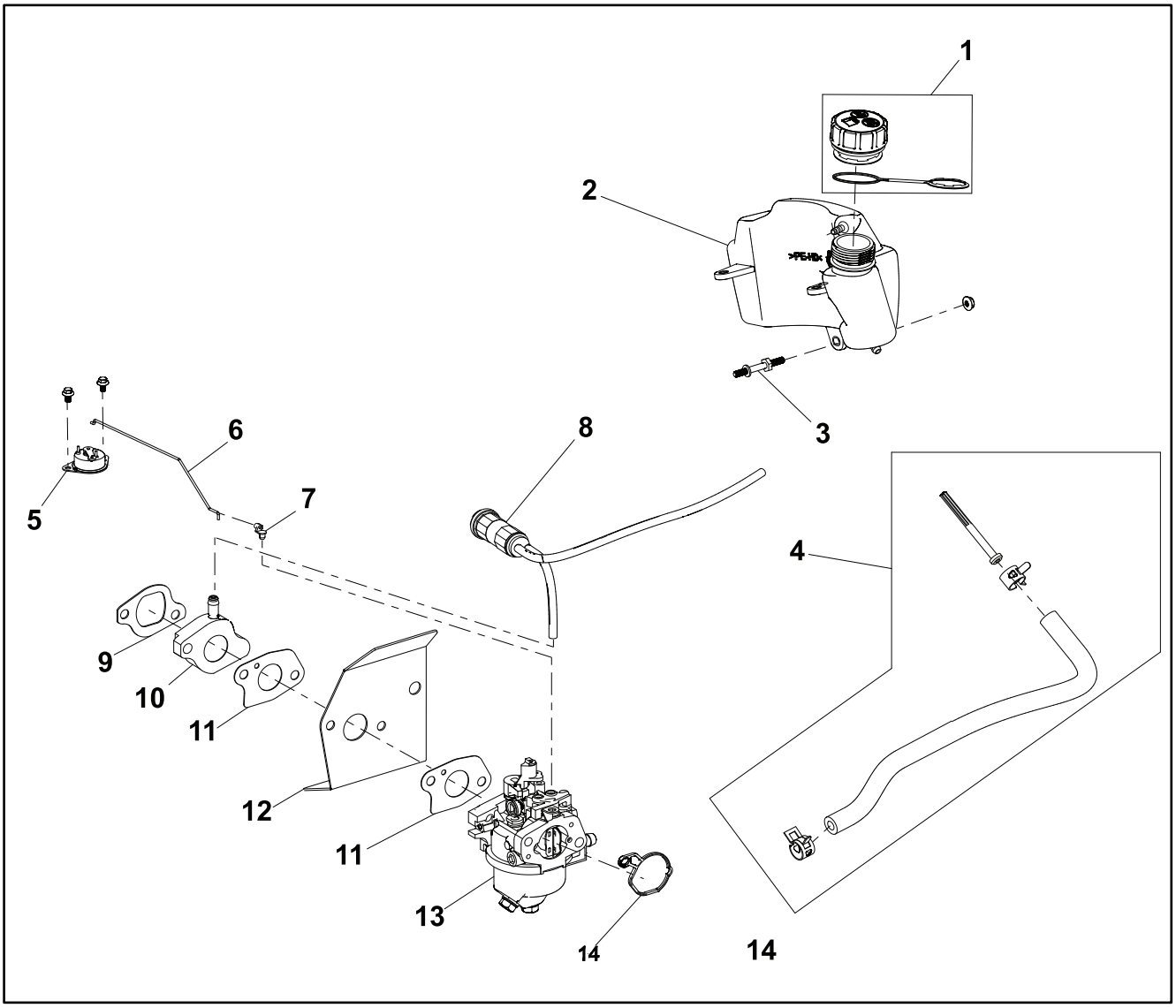

Figure 54

1. Sealed Fuel Cap
2. Fuel Tank
3. Stud Bolt
4. Fuel Line Kit
5. Thermal Control
6. Thermal Choke Linkage
7. Throttle Lock
8. 19 cc Carbon Canister
9. Intake Gasket
10. Carburetor Spacer
11. Carburetor Gasket
12. Carburetor Insulator
13. Carburetor
14. Carburetor Gasket

Carbon Canister Replacement

Carbon Canister Removal

1. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 55

2. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

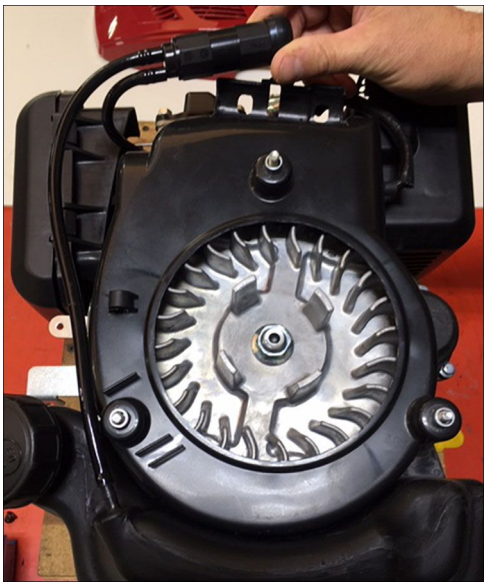

Figure 56

3. Remove the fuel tank vent hose from the fitting on the fuel tank.

Carbon Canister Removal (continued)

Figure 57

4. Remove the manifold vent hose from the intake manifold. Remove the carbon canister from the engine.

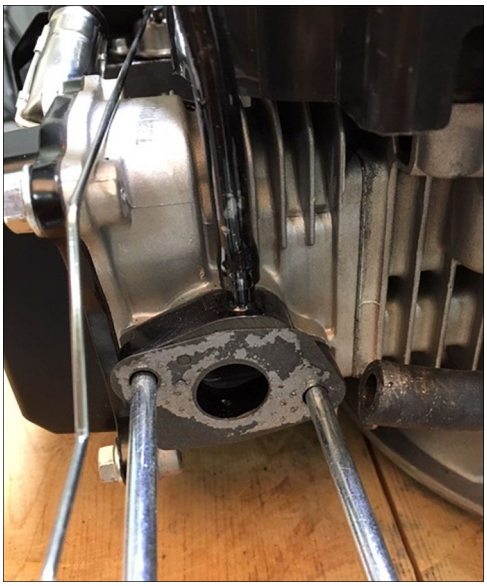

Figure 58

Carbon Canister Test

1. Connect a hand vacuum pump to the hose attached to the “V” port on the carbon canister.
2. Place a thumb over the hose attached to the “P” port on the carbon canister.
3. Apply a vacuum with the hand pump. If the vacuum builds at the vacuum pump gauge, replace the carbon canister assembly.

Carbon Canister Inspection

The fittings on the carbon canister are marked. The “T” is the longer hose leading to the fuel tank fitting. The “P” is the shorter hose leading to intake manifold.

Carbon Canister Inspection (continued)

Figure 59

Carbon Canister Installation

1. Install the manifold vent hose onto the intake manifold.

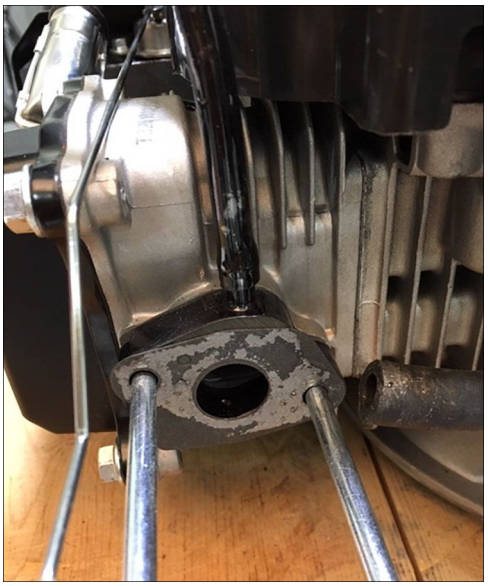

Figure 60

2. Install the fuel tank vent hose to the fitting on the fuel tank.

Figure 61

3. Install the fuel tank vent hose to the hose retainer on the engine shroud.

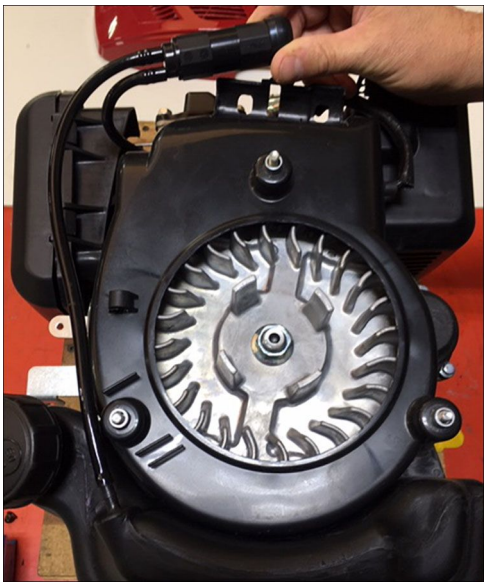

Figure 62

4. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 in-lbs. (6–10 Nm).

Figure 63

Fuel Filter and Hoses Replacement

Fuel Filter and Hoses Removal

1. Drain the fuel tank.
2. Push down on the 2 air filter cover latch tabs.

Figure 64

3. Hinge the air filter cover downward. Remove the cover from the air filter housing assembly.
4. Remove the air filter from the air filter housing.
5. Remove the 2 (10 mm) nuts securing the air filter housing to the engine.

Figure 65

6. Remove the air filter housing from the engine.
7. Remove the fuel hose clamp at the carburetor.
8. Remove the fuel hose from the carburetor.

   Note: Use a rag to catch excess fuel from hose removal.

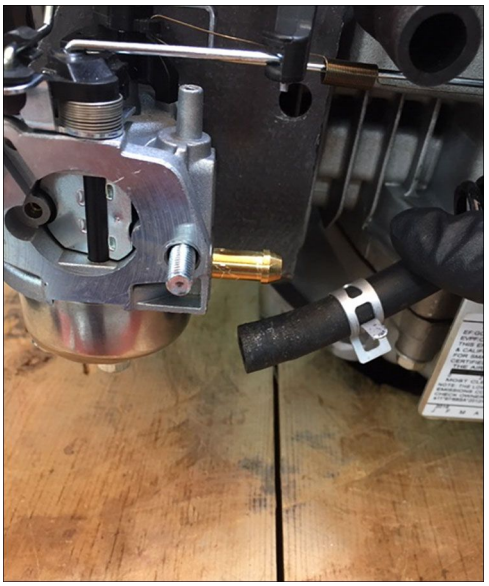

Figure 66

9. Remove the fuel hose clamp at the fuel tank.
10. Remove the fuel hose from the fuel tank.
11. Remove the fuel filter from the fuel hose.

    Note: Replace the fuel filter and fuel hose as necessary.

Fuel Filter and Hoses Removal (continued)

Figure 67

Fuel Filter and Hoses Inspection

Check the fuel filter screen for debris.

Fuel Filter and Hoses Installation

1. Install the fuel filter into the fuel tank fitting.

Figure 68

2. Install the fuel hose to the fuel tank. Secure with the fuel hose clamp.

Figure 69

3. Install the fuel hose to the carburetor. Secure with the fuel hose clamp.

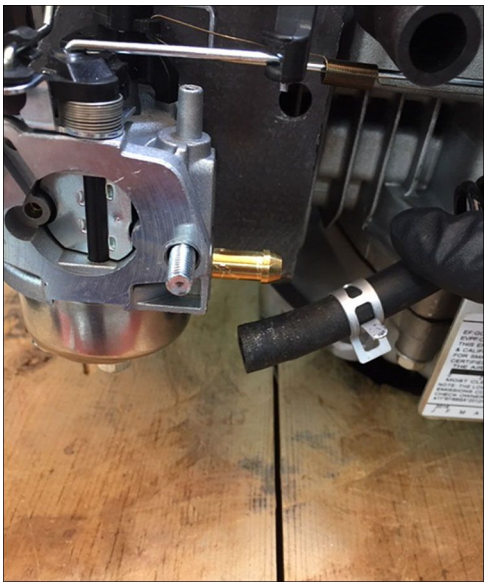

Figure 70

4. Install the air filter housing to the engine.

5. Install the air filter housing to the engine. Secure with 2 (10 mm) nuts securing the air filter housing to the engine. Torque nuts to 52–87 in-lbs. (6–10 Nm).

Figure 71

6. Install the air filter into the air filter housing.

Figure 72

7. Install the cover to the air filter housing assembly.
8. Hinge the air filter cover upward and lock into place.

Carburetor Replacement

Carburetor Removal

1. Push down on the 2 air filter cover latch tabs.
2. Hinge the air filter cover downward. Remove the cover from the air filter housing assembly.
3. Remove the air filter from the air filter housing.
4. Remove the 2 (10 mm) nuts securing the air filter housing to the engine.

Figure 73

5. Remove the air filter housing from the engine.
6. Loosen the hose clamp on the fuel hose.
7. Remove the fuel hose from the carburetor.

Figure 74

8. Remove the linkage connecting the air vein to the carburetor by pulling the air vein arm towards the breather hose. Lift the linkage upwards and remove from the air vein arm.

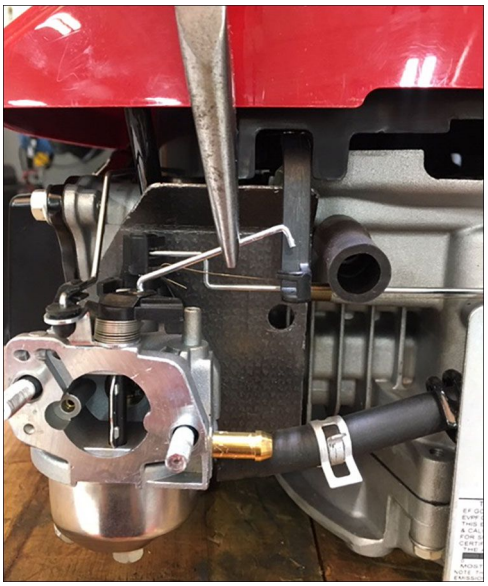

Figure 75

9. Remove the thermal control linkage from the carburetor by unhooking and sliding the linkage retainer outward.

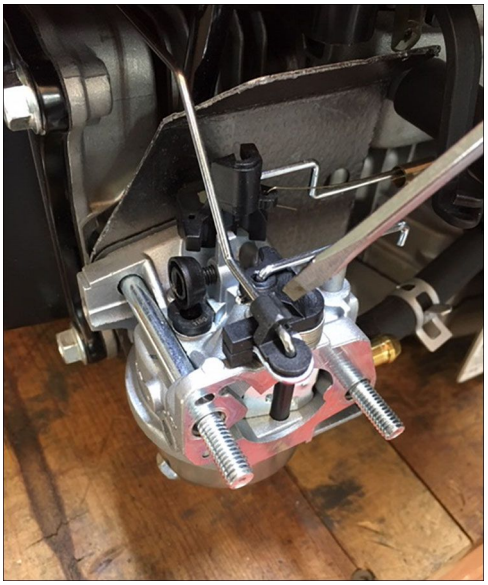

Figure 76

10. Remove the governor linkage from the governor arm by pivoting the arm towards the front of the engine for a wide open throttle. Then lift the governor linkage up and away from the carburetor.

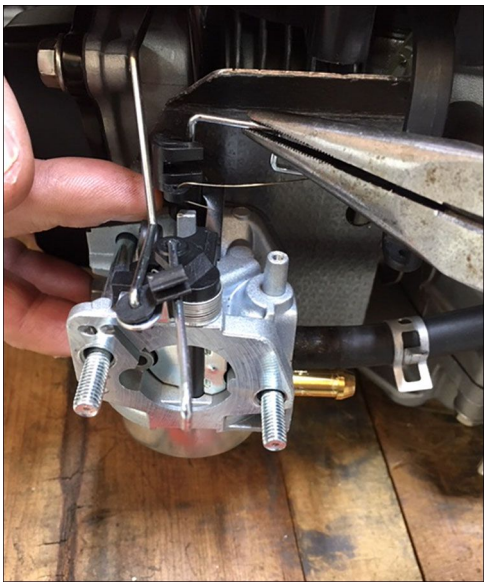

Figure 77

11. Lift upwards on the governor linkage spring and away from the carburetor.
12. Slide the carburetor away from the engine.

Figure 78

Carburetor Disassembly

1. Remove the 2 bolts (10 mm) securing the float bowl to carburetor body.

   Note: The center bolt is the float bowl mounting and the side bolt is the carburetor drain bolt.

Figure 79

2. Remove the float bowl from the carburetor body.

Figure 80

3. Remove the float pin from the carburetor body.

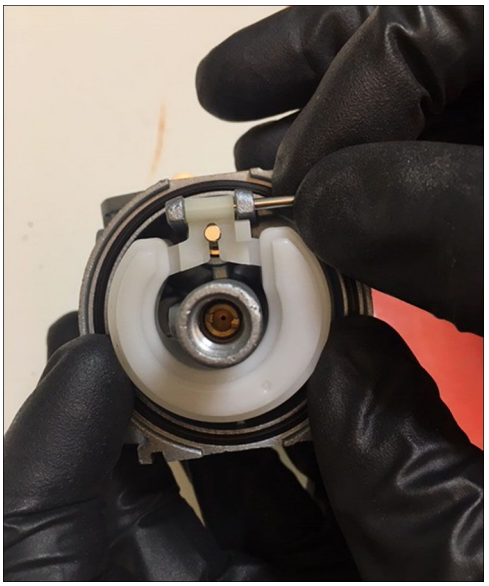

Figure 81

4. Remove the float and needle from the carburetor body.

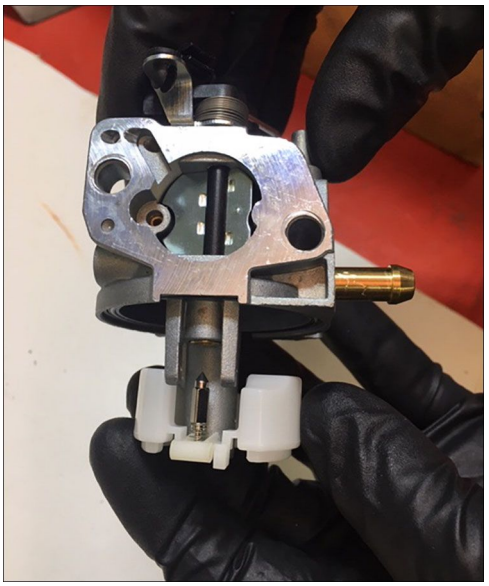

Figure 82

5. Remove the main jet from the carburetor body.

Figure 83

Carburetor Inspection

1. Check for debris (dirt or metal shaving) or build-up of old fuel.
2. Verify passages are open and free from debris blockage.
3. Check for dirt or old fuel residue in the carburetor. Clean the carburetor body and parts in an ultra sonic cleaner before reassembly.
4. Check the tip of the float needle for grooves or wear.

Carburetor Assembly

1. Install the main jet into the carburetor body.

Figure 84

2. Install the needle into the float and onto to the carburetor body.

Figure 85

3. Install the float pin through the carburetor body and float.

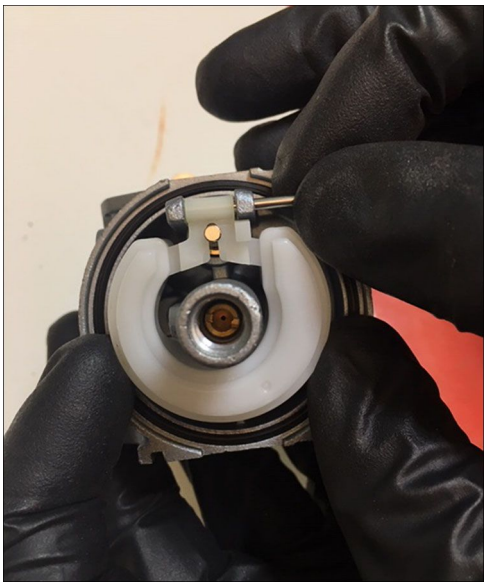

Figure 86

4. Install the float bowl onto the carburetor body.

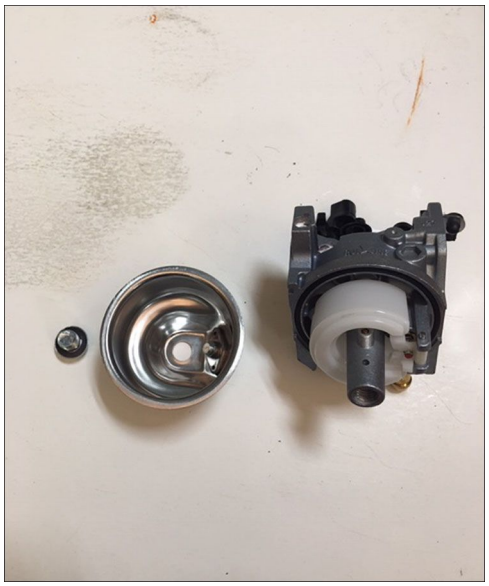

Figure 87

5. Install the 10 mm bolt securing the float bowl to carburetor body. Torque bolt to 52–79 in-lbs. (6–9 Nm).

Figure 88

Pop Off Test

1. Install the needle into the float and onto the carburetor body.
2. Position the carburetor with the float up.
3. Install the pressure tester onto the inlet fitting on the carburetor.

Pop Off Test (continued)

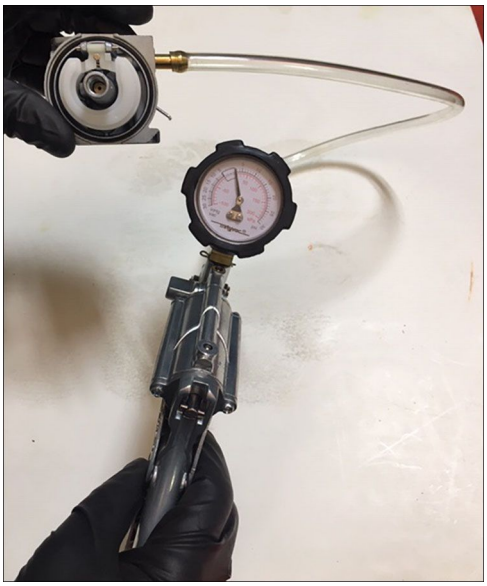

Figure 89

4. While pumping, observe the pressure increase.
5. Stop pumping, observe the pressure drop slightly, then stabilize as the float weight closes the needle and holds pressure. The pressure should not drop to zero.

Carburetor Installation

1. Slide the carburetor into position on the engine.

Figure 90

2. Install the governor linkage spring.
3. Install the governor linkage onto the governor arm.

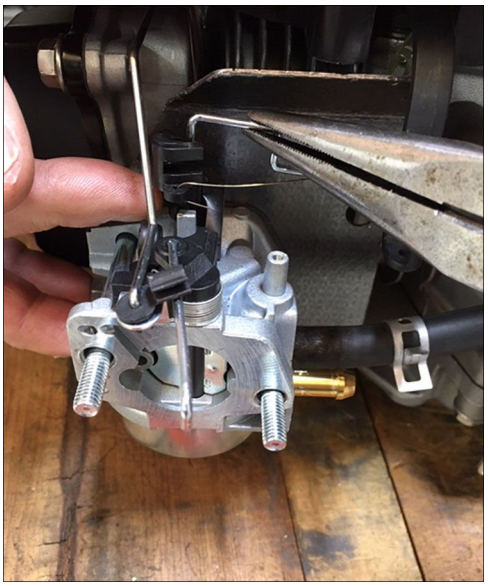

Figure 91

4. Install the thermal control linkage to the carburetor by hooking the linkage retainer inward.

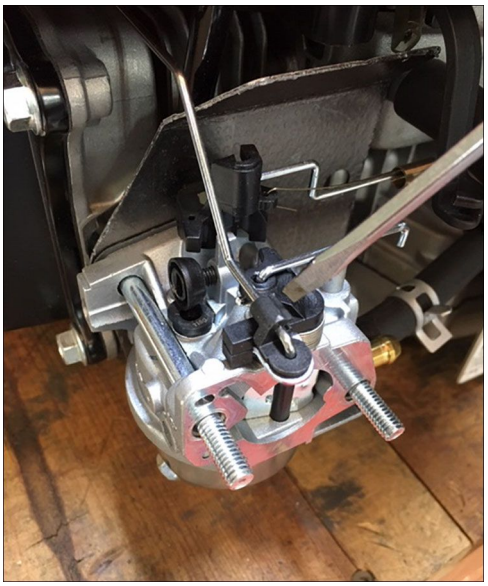

Figure 92

5. Install the linkage connecting the air vane to the carburetor.

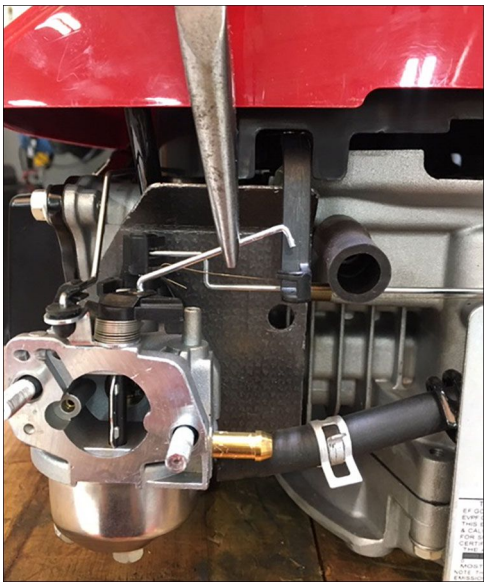

Figure 93

6. Install the fuel hose to the carburetor.

Figure 94

7. Tighten the hose clamp on the fuel hose.

8. Install the air filter housing to the engine. Secure with 2 (10 mm) nuts securing the air filter housing to the engine. Torque nuts to 52–87 in-lbs. (6–10 Nm).

Figure 95

9. Install the air filter into the air filter housing.

Figure 96

10. Install the cover to the air filter housing assembly.
11. Hinge the air filter cover upward and lock into place.

Auto Choke System/Thermal Control Replacement

Auto Choke System/Thermal Control Removal

1. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 97

2. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

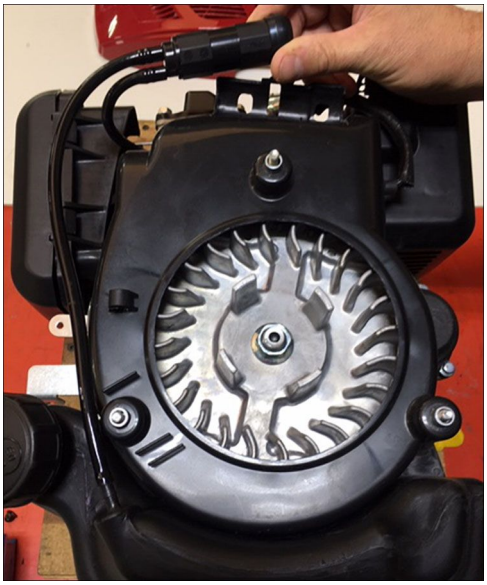

Figure 98

3. Remove the shroud by lifting away from the engine.
4. Remove the 2 (10 mm) nuts securing muffler to the cylinder head.

Figure 99

5. Remove the muffler cover from the muffler.
6. Remove the 2 (7 mm) thermal control mounting bolts from the muffler.

Figure 100

7. Remove the thermal control from the linkage.

Auto Choke System/Thermal Control Removal (continued)

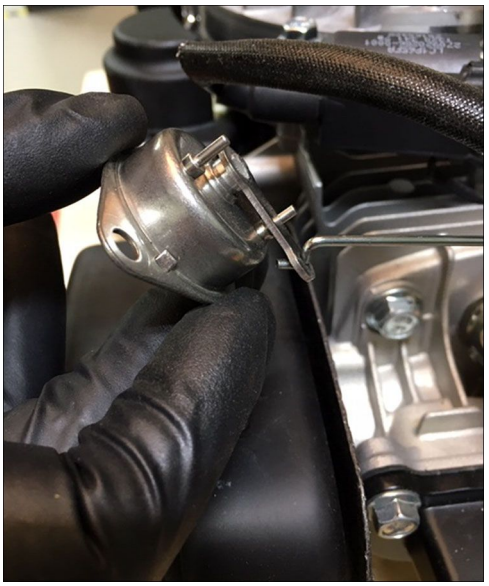

Figure 101

Auto Choke System/Thermal Control Inspection

Verify the thermal control arm moves freely and returns to stop.

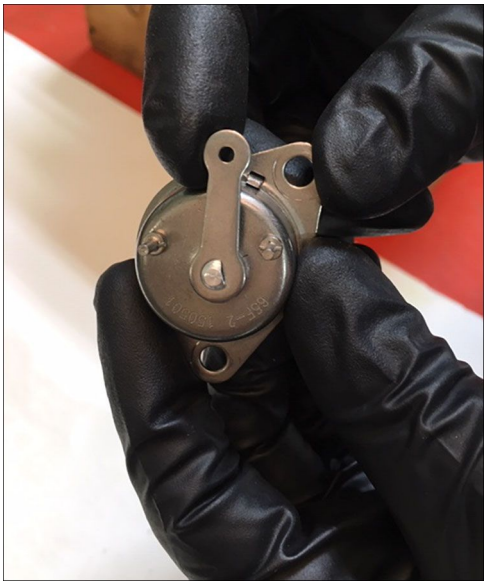

Figure 102

Auto Choke System/Thermal Control Installation

1. Install the thermal control to the linkage.

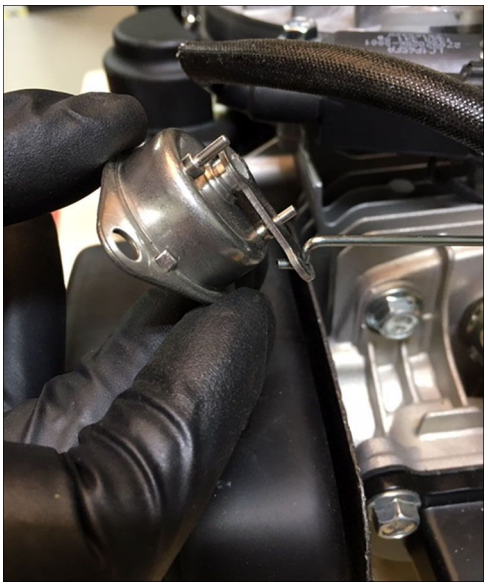

Figure 103

2. Install the 2 (7 mm) thermal control mounting bolts to the muffler. Torque mounting bolts to 54 in-lbs. (6 Nm).

Figure 104

3. Install the muffler cover to the muffler.

4. Install the 2 (10 mm) nuts securing the muffler to the cylinder head. Torque nuts to 70–105 in-lbs. (8–12 Nm).

Figure 105

5. Install the shroud onto the engine.
6. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

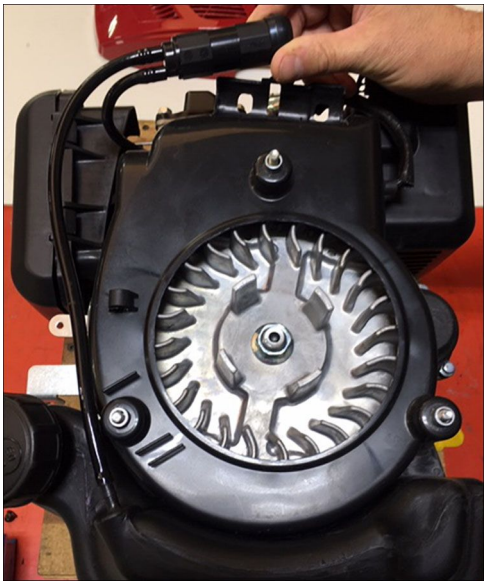

Figure 106

7. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 in-lbs. (6–10 Nm).

Figure 107

Control Plate Replacement

Control Plate Removal

1. Remove the spring from the governor arm.

   Note: Note the position of the spring.

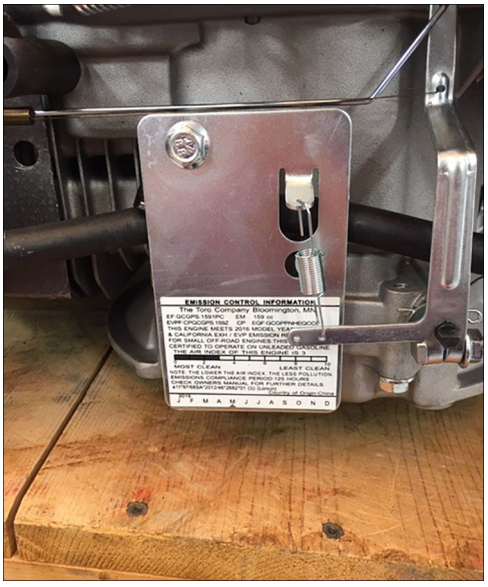

Figure 108

2. Remove the 10 mm bolt securing the control plate to the crankcase.

Control Plate Removal (continued)

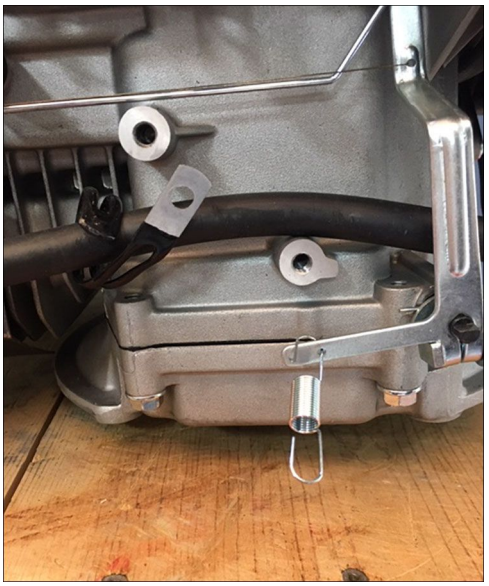

Figure 109

3. Remove the control plate from the crankcase.

Figure 110

Control Plate Installation

1. Install the control plate onto the crankcase.
2. Secure the spring to the governor arm.

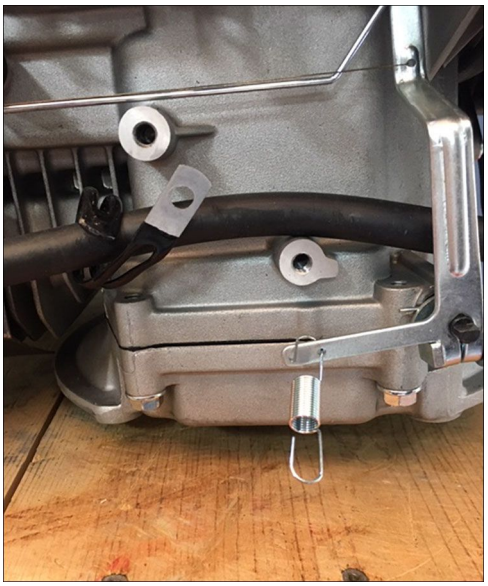

Figure 111

3. Install the bolt securing the control plate to the crankcase. Torque bolt to 90 in-lbs. (10 Nm).

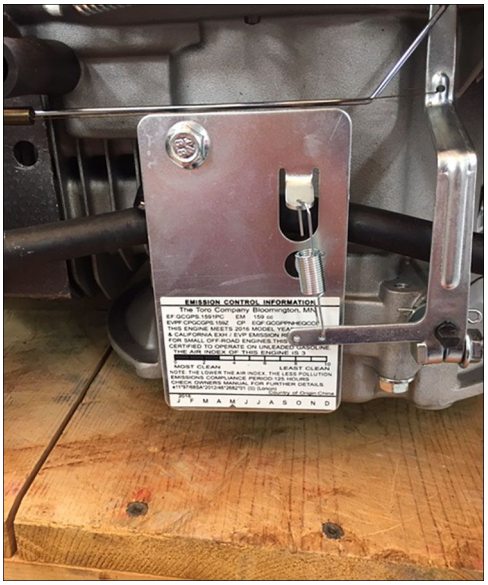

Figure 112

Compression System

Table of Contents

General Information

This chapter covers the complete disassembly, inspection, adjustment, and assembly of the engine compression system. The 1P65F-2 engine is an overhead valve design. The camshaft is equipped with an automatic compression release and operates the valves through a push rod and rocker arm system.

Service and Repairs

Compression System Assembly 1

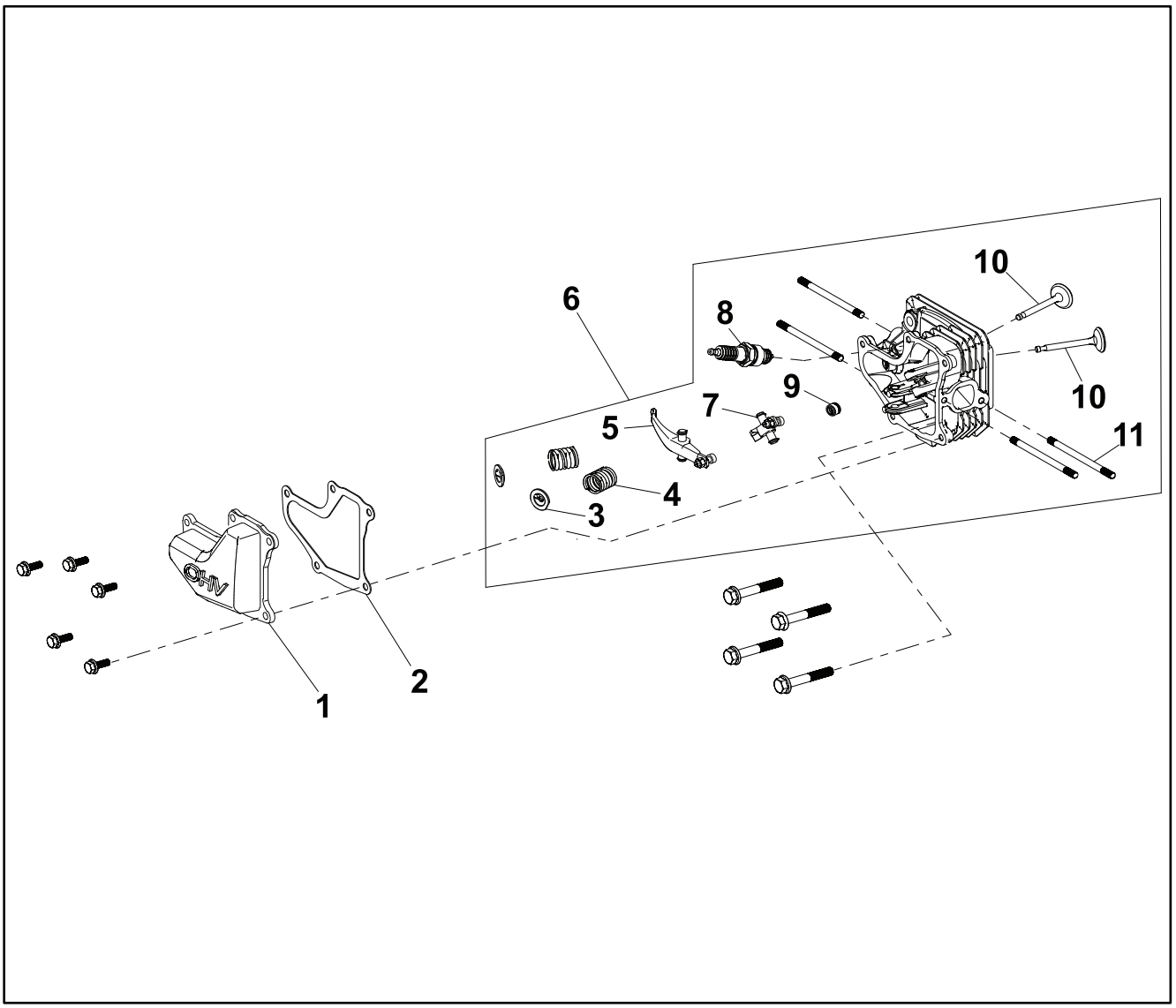

Figure 113

1. Valve Cover
2. Valve Cover Gasket
3. Spring Valve Retainer
4. Valve Spring
5. Exhaust Rocker Arm Asm.
6. Complete Head Asm.
7. Intake Rocker Arm Asm.
8. Spark Plug
9. Valve Stem Seal
10. Valve Set
11. Exhaust Stud

Compression System Assembly 2

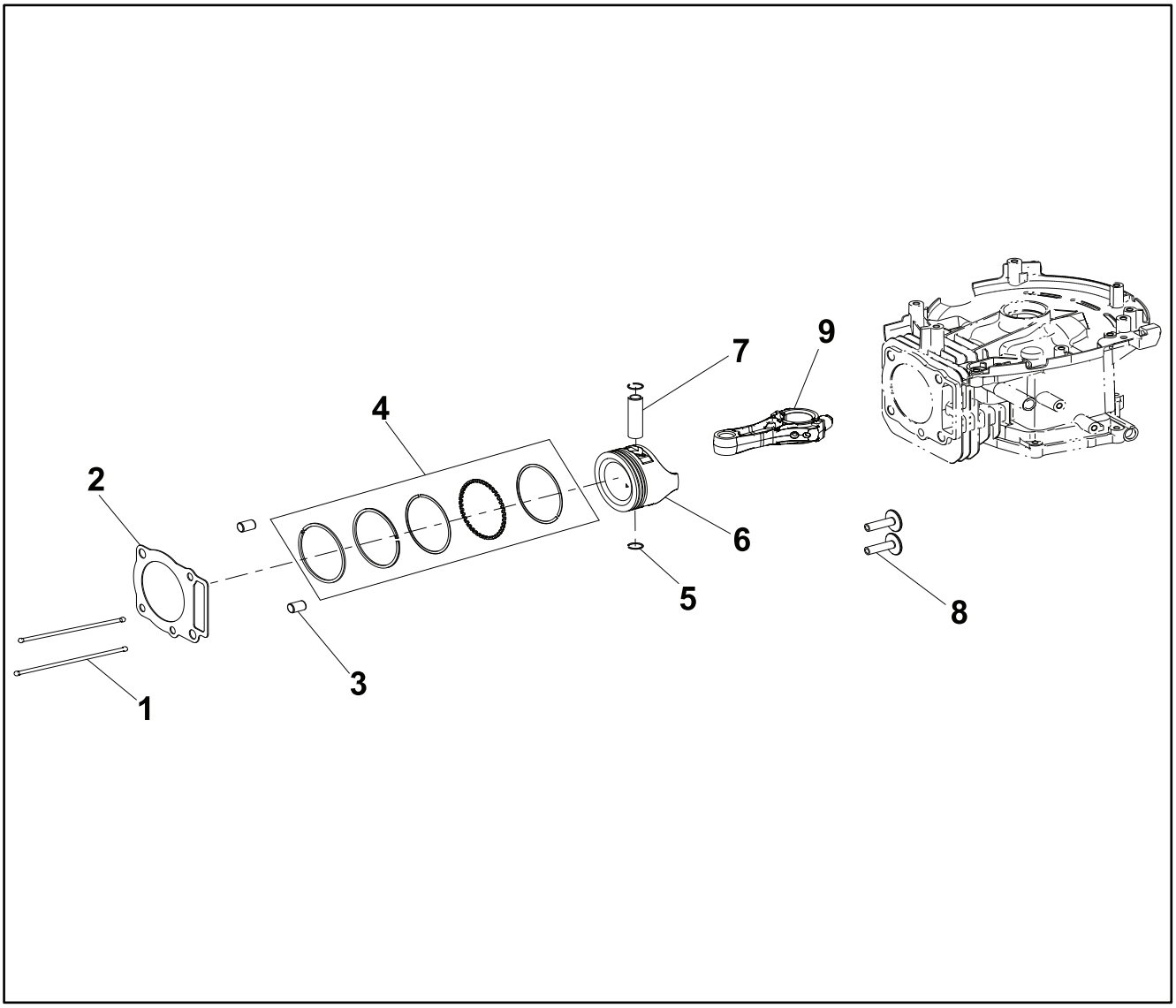

Figure 114

1. Push Rod
2. Head Gasket
3. Dowel Pin
4. Piston Ring Set
5. Wrist Pin Clip
6. Piston
7. Piston Pin
8. Valve Tappet
9. Connecting Rod Asm.

Compression System Assembly 3

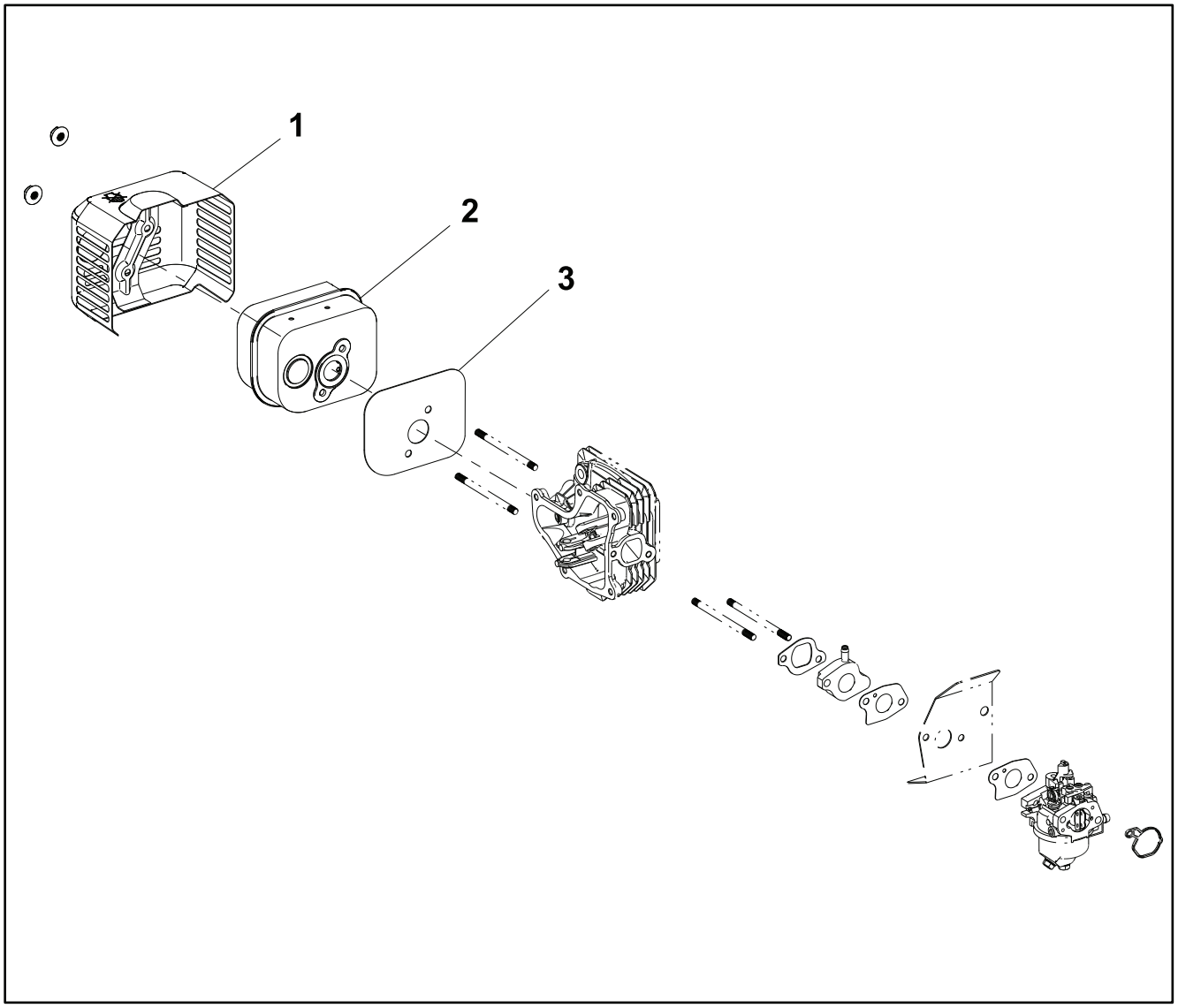

Figure 115

1. Muffler Shield
2. Muffler Asm.
3. Exhaust Gasket

Cylinder Head Replacement

Cylinder Head Removal

1. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 116

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2. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

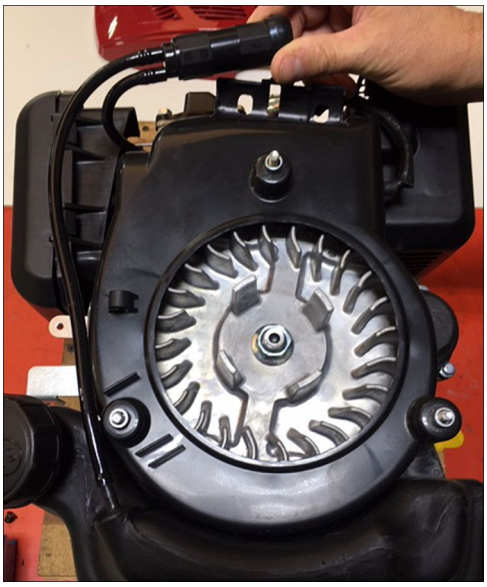

Figure 117

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3. Remove the shroud by lifting away from the engine.
4. Push down on the 2 air filter cover latch tabs.

Figure 118

5. Hinge the air filter cover downward. Remove the cover from the air filter housing assembly.
6. Remove the air filter from the air filter housing.
7. Remove the 2 (10 mm) nuts securing the air filter housing to the engine.

Figure 119

8. Remove the air filter housing from the engine.
9. Loosen the hose clamp on the fuel hose.
10. Remove the fuel hose from the carburetor.

Figure 120

11. Remove the linkage connecting the air vein to the carburetor by pulling the air vein arm towards the breather hose. Lift the linkage upwards and remove from the air vein arm.

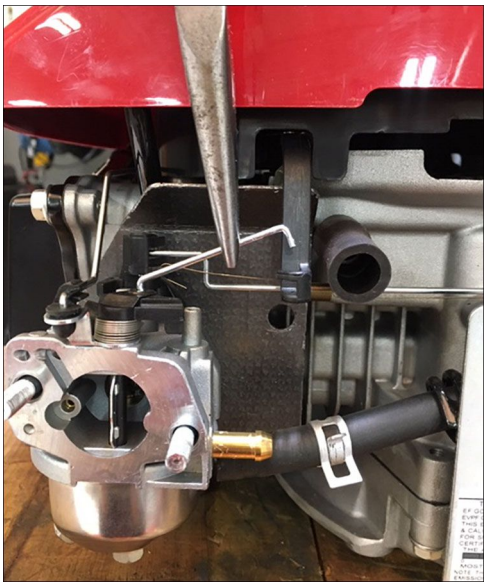

Figure 121

12. Remove the thermal control linkage from the carburetor by unhooking and sliding the linkage retainer outward.

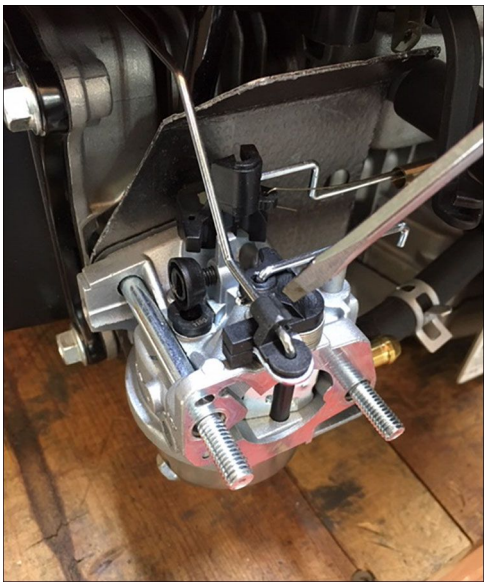

Figure 122

13. Remove the governor linkage from the governor arm by pivoting the arm towards the front of the engine, opening the throttle wide. Then lift the governor linkage up and away from the carburetor.

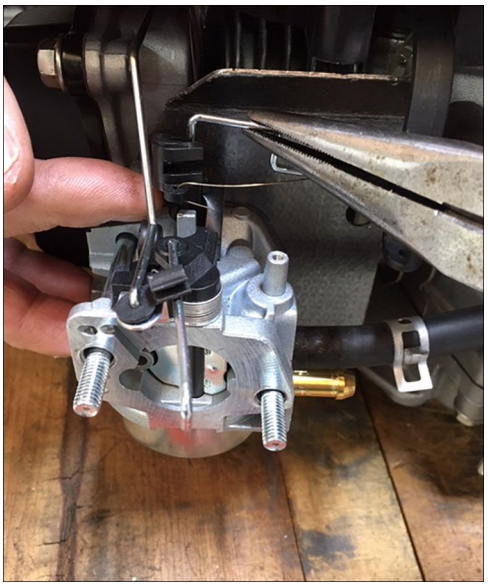

Figure 123

14. Lift upwards on the governor linkage spring and away from the carburetor.
15. Slide the carburetor away from the engine.

Figure 124

16. Remove the 2 (10 mm) nuts securing muffler to the cylinder head.

Figure 125

17. Remove the muffler cover from the muffler.
18. Remove the muffler and muffler gasket from the cylinder head.
19. Remove the spark plug wire from the spark plug.

Figure 126

20. Remove the spark plug from the cylinder head.

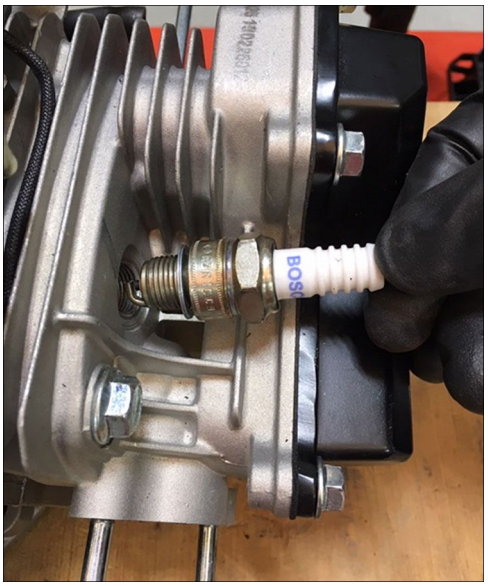

Figure 127

21. Remove the 5 (10 mm) bolts securing the valve cover to the cylinder head.

Figure 128

22. Remove the valve cover from the cylinder head.

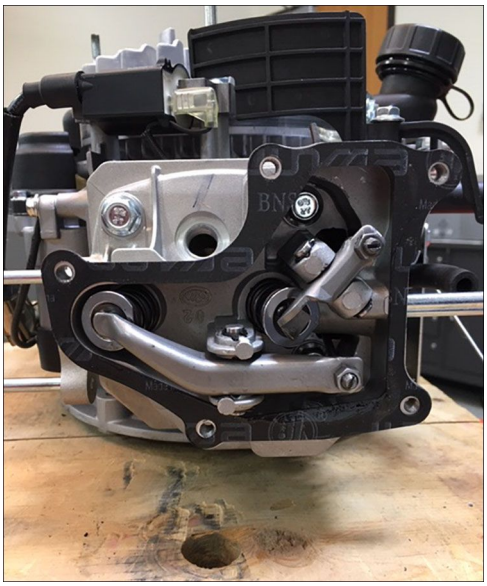

Figure 129

23. Remove the circlip from the exhaust valve rocker arm pivot pin.

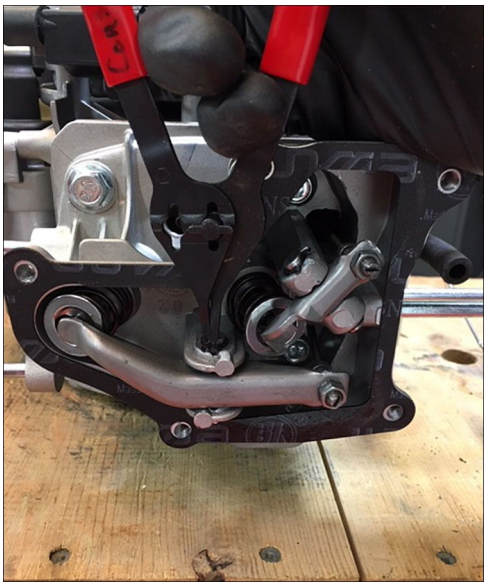

Figure 130

24. Remove the rocker arm pivot pin.

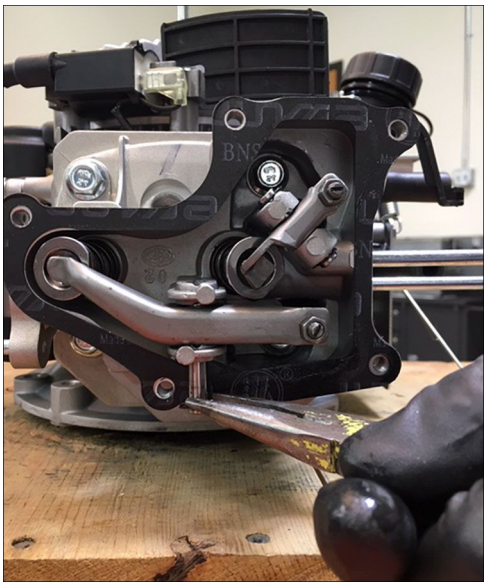

Figure 131

25. Remove the rocker arm from the cylinder head.

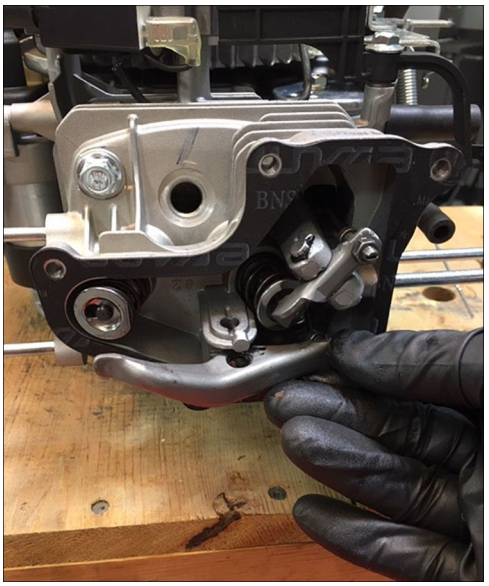

Figure 132

26. Remove the 4 (12 mm) bolts securing the cylinder head to the crankcase.

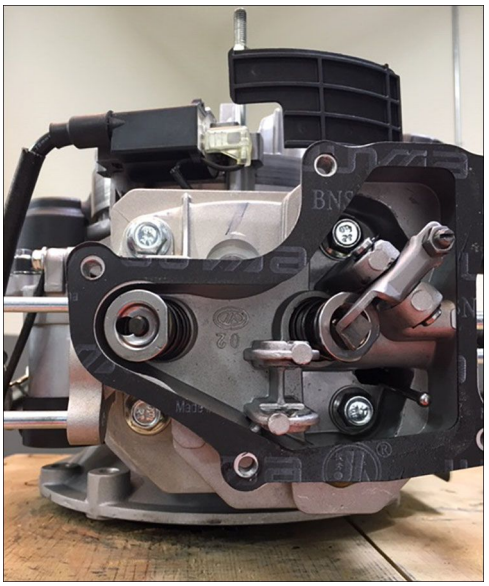

Figure 133

27. Remove the cylinder head from the crankcase.

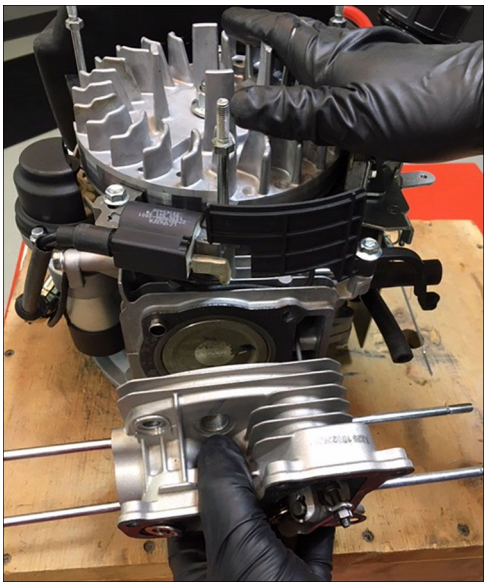

Figure 134

Cylinder Head Disassembly

1. Push down on the valve retainer and slide towards the large end of the slot to release the retainer from the valve.

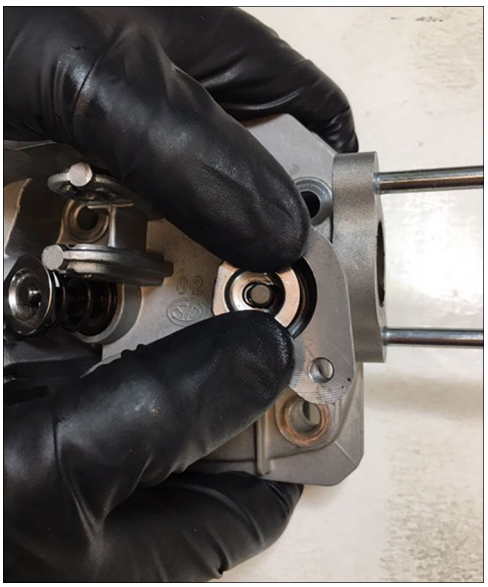

Figure 135

2. Repeat for opposite valve.
3. Remove the circlip from the intake valve rocker arm pivot pin.

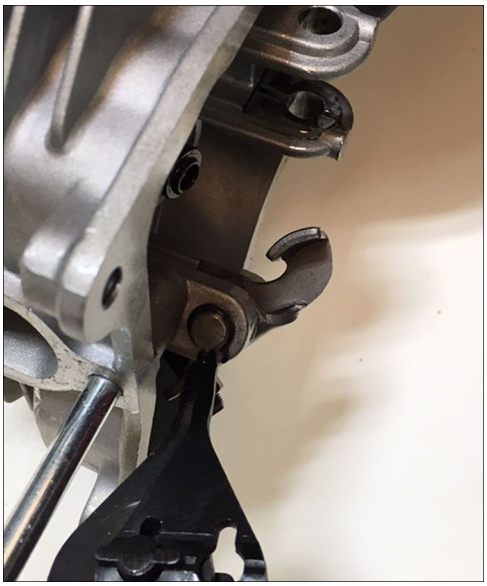

Figure 136

4. Remove the pivot pin and rocker arm from the cylinder head.

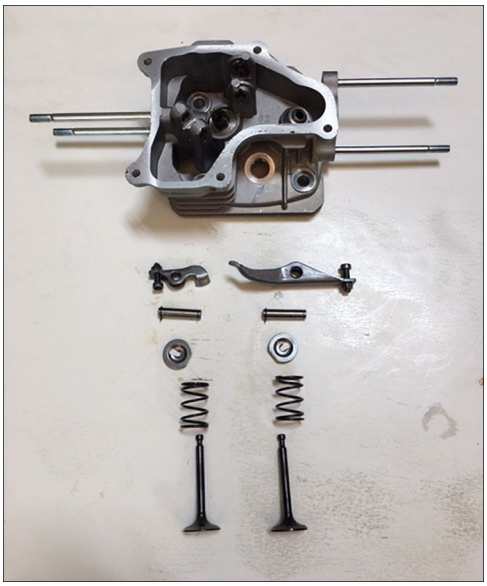

Figure 137

Cylinder Head Cleaning Inspection

1. Remove the carbon deposits from the cylinder head.
2. Clean the cylinder head of any remaining gasket material; intake, exhaust, valve cover, and head gaskets.
3. Inspect the cylinder head for cracks, specifically around the following:

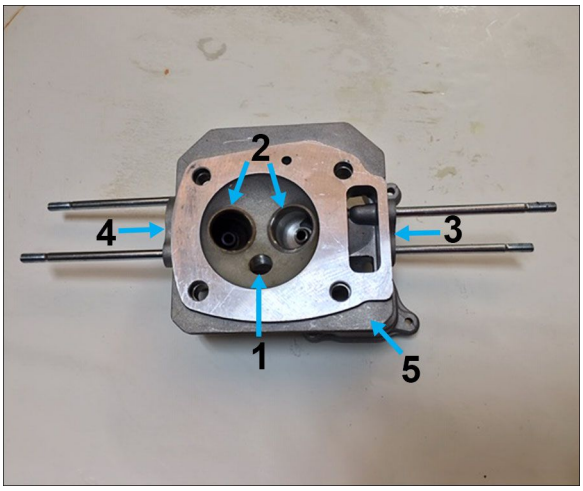

Figure 138

1. Spark Plug Threads
2. Valve Seats
3. Intake Port
4. Exhaust Port
5. Coolant Fins

4. Inspect the cylinder head for warpage using a straight edge and feeler gauge. Measure and compare to specifications:

   Service Limit: 0.002 in.

5. Inspect the intake and exhaust ports mounting surface for warpage.

Cylinder Head Valve Seat Inspection

1. Thoroughly clean the cylinder head to remove carbon deposits.
2. Inspect the valve seats for loose seat, proper valve face contact, and proper seat width.

   Standard: 0.028–0.030 in.

   Service Limit: 0.040 in.

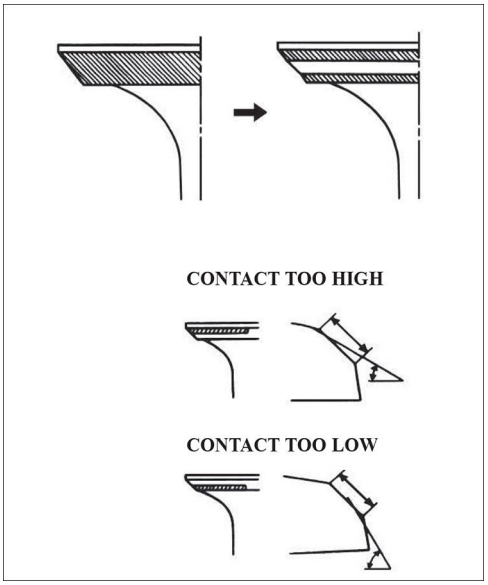

Figure 139

3. Repeat the inspection for all valves and seats.

Valve Face Contact Test

1. Apply a light coat of Prussian Blue or erasable tipped marker ink to the valve face.
2. Insert the valve, lift the valve and snap closed against the seat several times.

   Note: Be sure the valve does not rotate on the seat.
3. Inspect the transferred making compound for any area of the seat that is not concentric.
4. Replace the cylinder head if any of the above items are found out of specification.

Valve Guide Inspection

1. Measure and compare to specifications:

   Inside Diameter (Intake and Exhaust) Standard: 0.2598–0.2604 in. (6.60–6.615 mm)

   Service Limit: 0.2624 in. (6.665 mm)
2. Replace the cylinder head if any of the above items are found to be out of specification.

Valve Inspection

1. Clean carbon from the valve.

Figure 140

---

2. Inspect the valve stem for pitting, wear or bent. Compare to standard:

   Intake Standard: 0.216 in. (5.48 mm)

   Intake Service Limit: 0.209 in. (5.318 mm)

   Exhaust Standard: 0.214 in. (5.44 mm)

   Exhaust Service Limit: 0.208 in. (5.275 mm)
3. Inspect the valve face for pitting, wear or corrosion.
4. Replace the valve if encounter any of the items above.
5. Repeat inspection for all valves.

Valve Spring

1. Inspect the free length of the valve spring.

Valve Spring (continued)

Valve Spring Standard: 1.202 in. (30.5 mm)

Service Limit: 1.141 in. (29.0 mm)

Figure 141

2. Inspect for bent coils of the spring (spring should stand straight).

Valve Mounting Components

Clean and inspect all other valve mounting components including the spring retainers, keepers, and spring seats.

Cylinder Head Assembly

1. Install the pivot pin and rocker arm to the cylinder head.

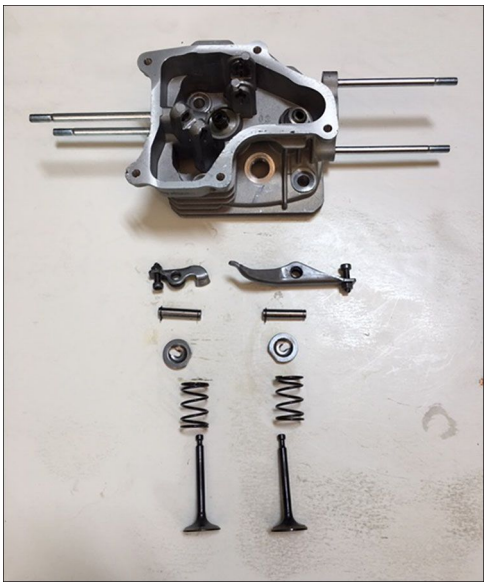

Figure 142

2. Install the circlip to the intake valve rocker arm pivot pin.

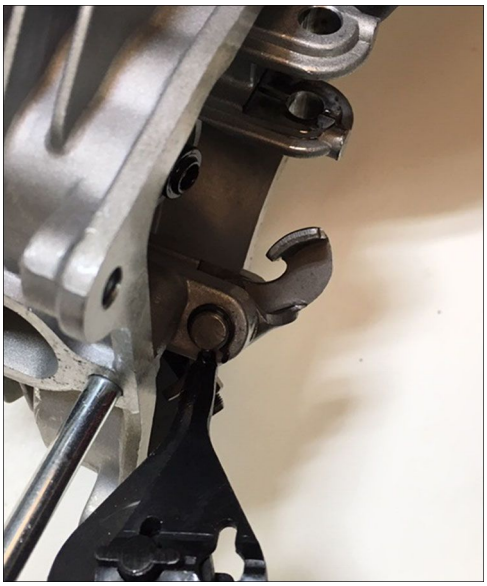

Figure 143

3. Repeat for opposite valve.
4. To secure the retainer to the valve, push down on the valve retainer and slide away from the large end of the slot.

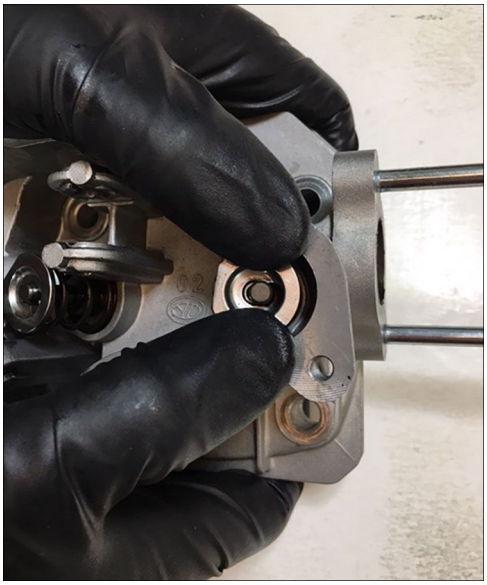

Figure 144

Cylinder Head Installation

1. Install the cylinder head to the crankcase.

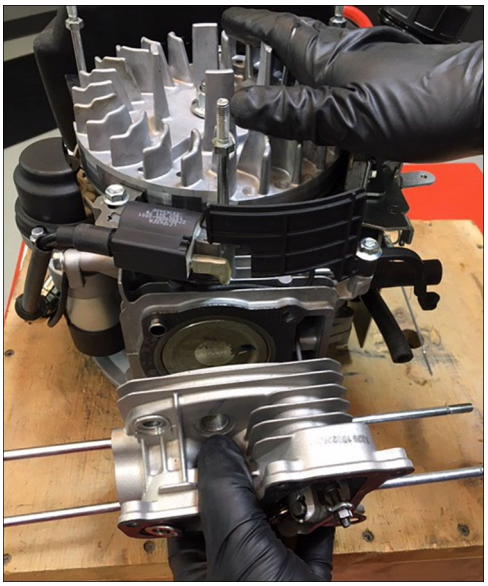

Figure 145

2. Install the 4 (12 mm) bolts securing the cylinder head to the crankcase. Torque bolts to 22–26 ft-lbs. (30–36 Nm).

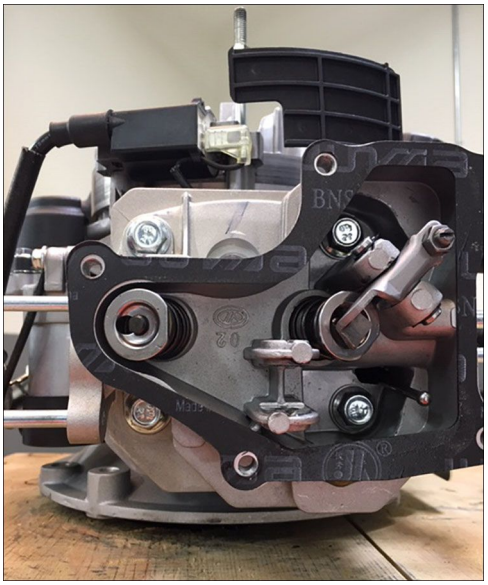

Figure 146

3. Install the rocker arm to the cylinder head.

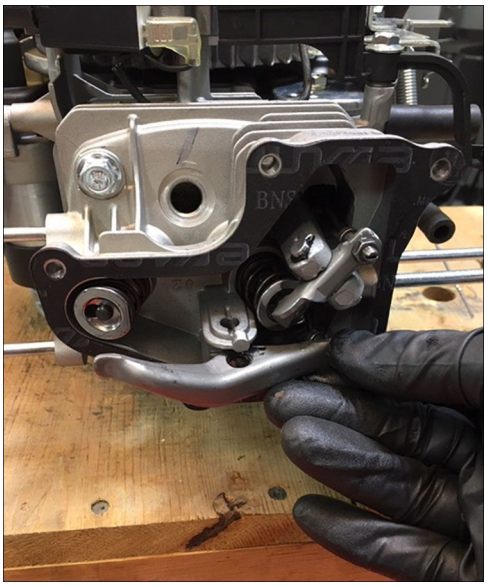

Figure 147

4. Install the rocker arm pivot pin.

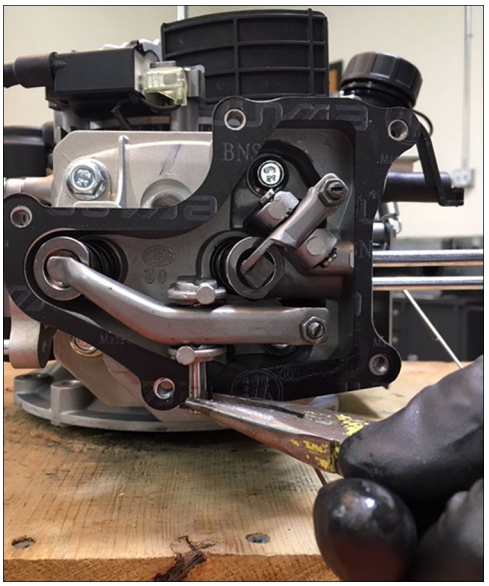

Figure 148

5. Install the circlip to the exhaust valve rocker arm pivot pin.

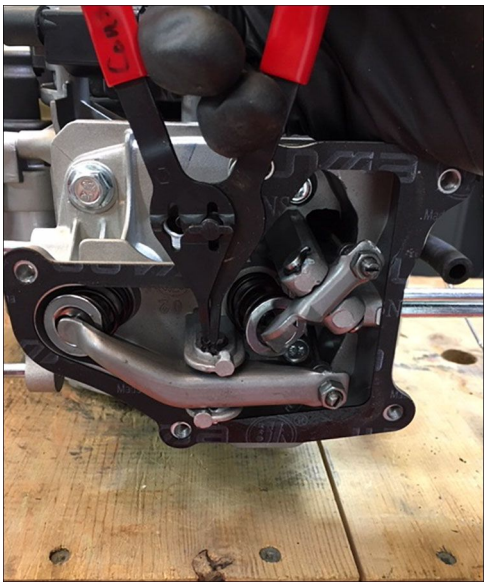

Figure 149

6. Install the valve cover to the cylinder head.

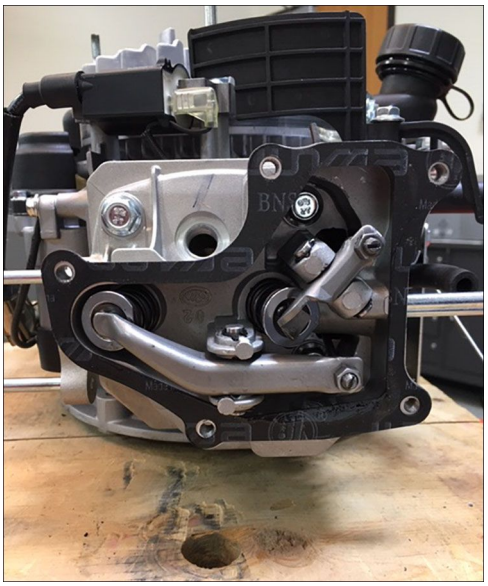

Figure 150

7. Install the 5 (10 mm) bolts securing the valve cover to the cylinder head. Torque bolts to 72 in-lbs. (8 Nm).

Figure 151

8. Install the spark plug to the cylinder head.

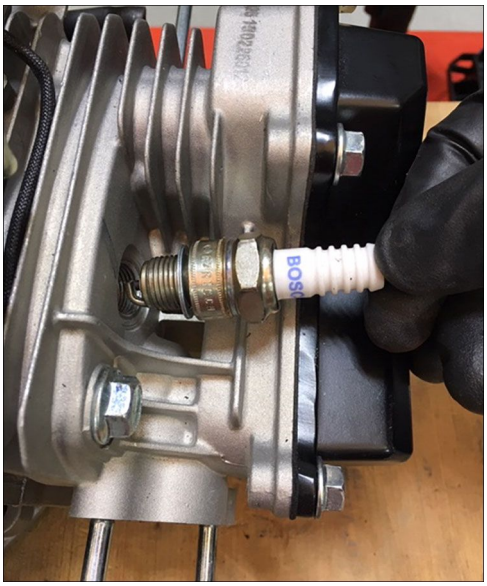

Figure 152

9. Install the spark plug wire to the spark plug. Torque the spark plug to 22 ft-lbs.(30 Nm).

Figure 153

10. Install the muffler and muffler gasket to the cylinder head.
11. Install the muffler cover to the muffler.
12. Install the 2 (10 mm) nuts securing the muffler to the cylinder head. Torque nuts to 70–105 in-lbs. (8–12 Nm).

Figure 154

13. Slide the carburetor into position on the engine.

Figure 155

14. Install the governor linkage spring.
15. Install the governor linkage onto the governor arm.

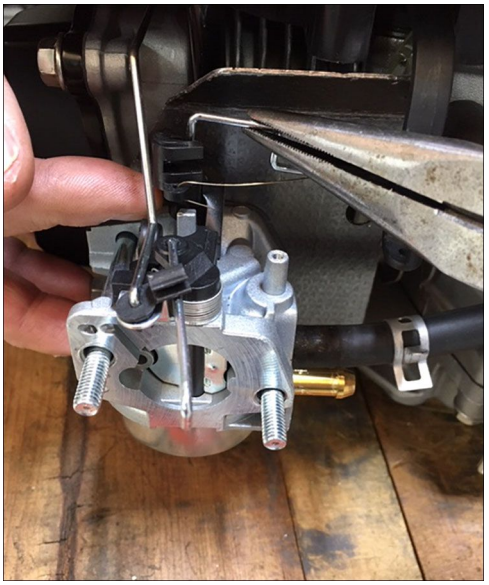

Figure 156

16. Install the thermal control linkage to the carburetor by hooking the linkage retainer inward.

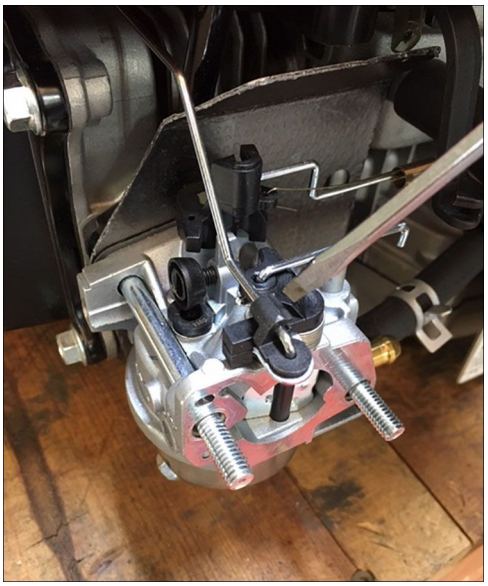

Figure 157

17. Install the linkage connecting the air vein to the carburetor.

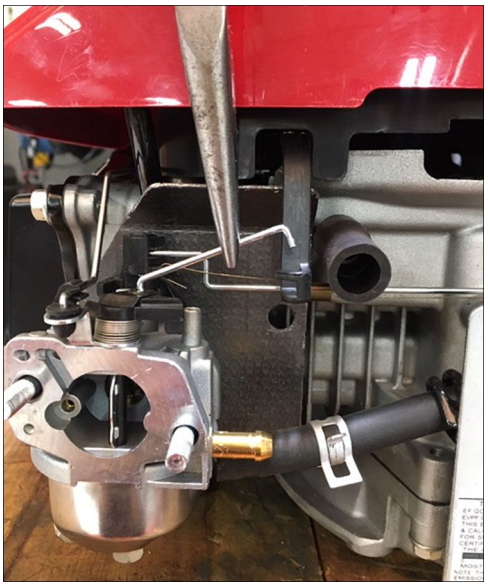

Figure 158

18. Install the fuel hose to the carburetor.

Figure 159

19. Tighten the hose clamp on the fuel hose.

20. Install the air filter housing to the engine. Secure with 2 (10 mm) nuts securing the air filter housing to the engine. Torque nuts to 52–87 in-lbs. (6–10 Nm).

Figure 160

21. Install the air filter into the air filter housing.

Figure 161

22. Install the cover to the air filter housing assembly.
23. Hinge the air filter cover upward and lock into place.
24. Install the shroud onto the engine.
25. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

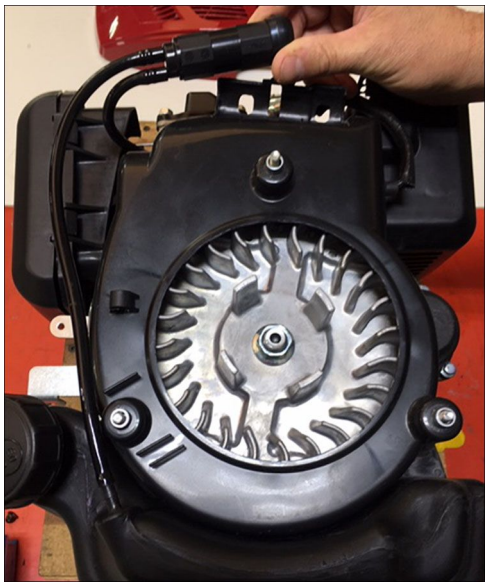

Figure 162

26. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 in-lbs. (6–10 Nm).

Figure 163

Connecting Rod Replacement

Connecting Rod Removal

1. Drain the oil.
2. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 164

3. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

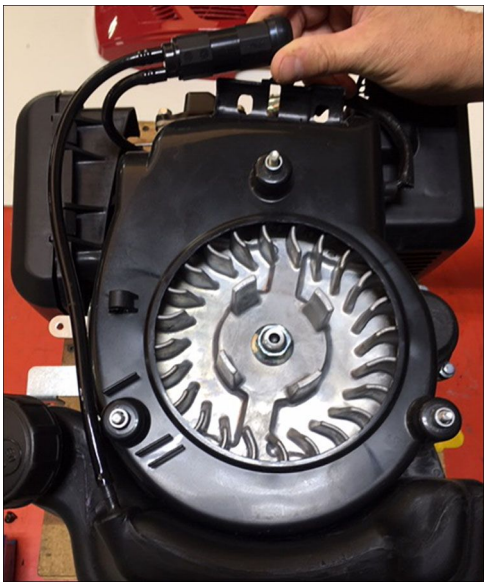

Figure 165

4. Remove the shroud by lifting away from the engine.
5. Loosen the nut securing the crankshaft to the engine.
6. Unhook the spring from the brake mechanism.

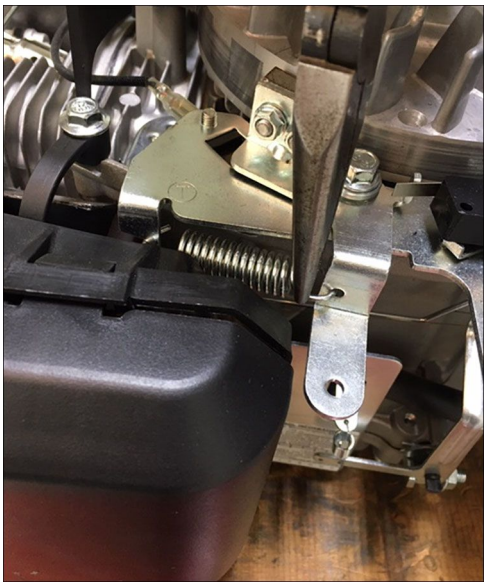

Figure 166

7. Place a pry bar under the flywheel to pry the flywheel upwards. Use a soft based hammer, to loosen the flywheel assembly from the crankshaft, only striking the top of the nut to prevent crankshaft damage.

Figure 167

8. Remove the nut from the crankshaft. Remove the flywheel from the engine.

Figure 168

9. Turn the motor upside down.
10. Remove the cylinder head assembly from the engine.
11. Remove the 7 (10 mm) bolts securing the sump cover to the crankcase.

Figure 169

12. Using a soft base hammer, tap the sump cover to remove from the crankcase.

Figure 170

13. Remove the sump cover from the crankcase.

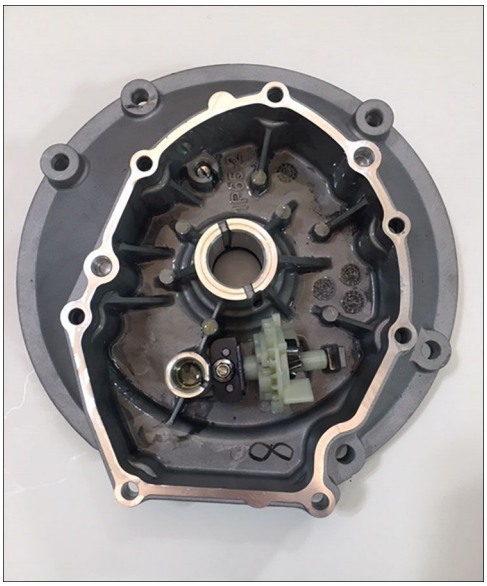

Figure 171

14. Remove the thrust washer from the crankshaft.

Figure 172

15. Turn the crankshaft clockwise, match the timing marks between the camshaft and crankshaft.

Figure 173

16. Remove the camshaft from the crankcase.
17. Remove the 2 (10 mm) connecting rod cap bolts.

Figure 174

18. Remove the connecting rod cap.

Figure 175

19. Remove the connecting rod and piston.

Figure 176

Connecting Rod Inspection

1. Inspect the connecting rod and cap bearing surfaces for wear and scoring.

Connecting Rod Inspection (continued)

Figure 177

2. Check the wrist pin bearing surface of the connecting rod for wear and scoring.

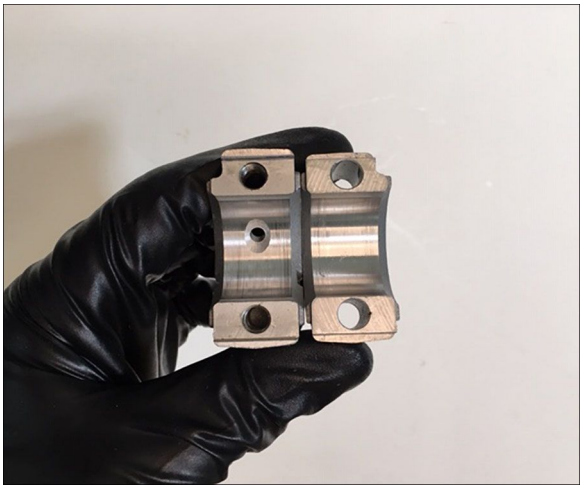

Figure 178

Connecting Rod Installation

1. Install the connecting rod and piston.

Figure 179

2. Install the connecting rod cap.

Figure 180

3. Install the 2 (10 mm) connecting rod cap bolts. Torque bolts to 108–132 in-lbs. (13–15 Nm).

Figure 181

4. Install the camshaft to the crankcase.
5. Verify the camshaft and crankshaft timing marks match.

Figure 182

6. Install the thrust washer onto the crankshaft.

Figure 183

7. Install the sump cover to the crankcase. Secure the crankcase with 7 (10 mm) bolts. Torque the bolts to 70–105 in-lbs. (8–12 Nm).

Figure 184

8. Turn the motor over.
9. Install the flywheel onto the engine.

Figure 185

10. Install the nut holding the flywheel to the crankshaft. Torque nut to 59–66 ft-lbs. (80–90 Nm).

11. Hook the spring to the brake mechanism.

Figure 186

12. Install the shroud onto the engine.

13. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

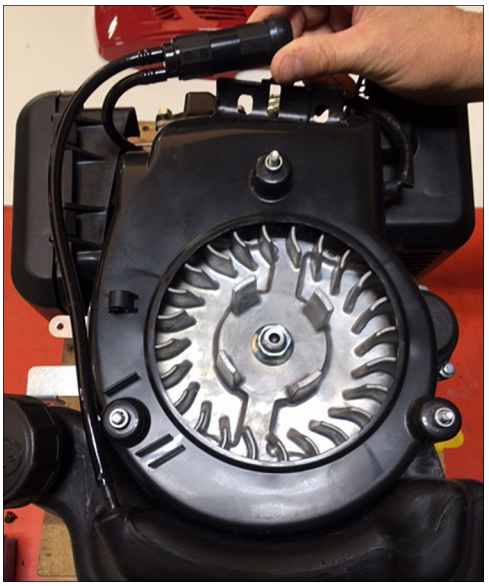

Figure 187

14. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 in-lbs. (6–10 Nm).

Figure 188

15. Add oil to the engine.

Piston and Rings Assembly Replacement

Piston and Rings Assembly Removal

1. Drain the oil.
2. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 189

3. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

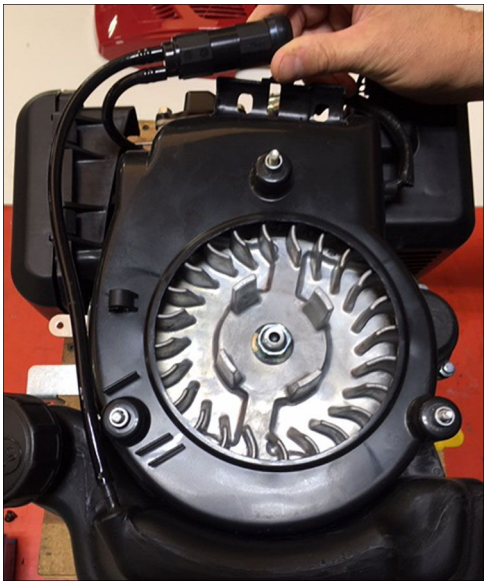

Figure 190

4. Remove the shroud by lifting away from the engine.
5. Push down on the 2 air filter cover latch tabs.
6. Hinge the air filter cover downward. Remove the cover from the air filter housing assembly.
7. Remove the air filter from the air filter housing.
8. Remove the 2 (10 mm) nuts securing the air filter housing to the engine.

Figure 191

9. Remove the air filter housing from the engine.
10. Loosen the hose clamp on the fuel hose.
11. Remove the fuel hose from the carburetor.

Figure 192

12. Remove the linkage connecting the air vein to the carburetor by pulling the air vein arm towards the breather hose. Lift the linkage upwards and remove from the air vein arm.

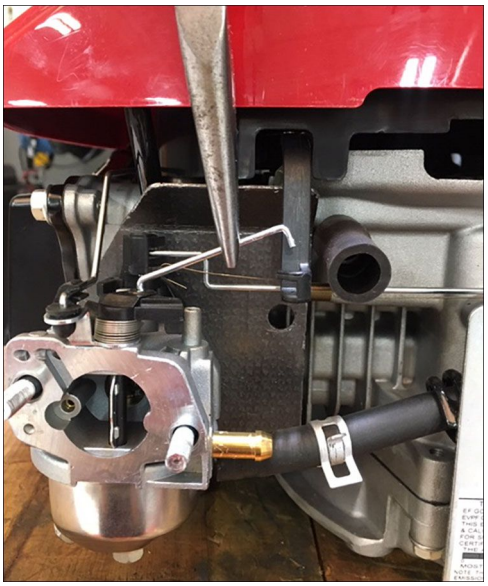

Figure 193

13. Remove the thermal control linkage from the carburetor by unhooking and sliding the linkage retainer outward.

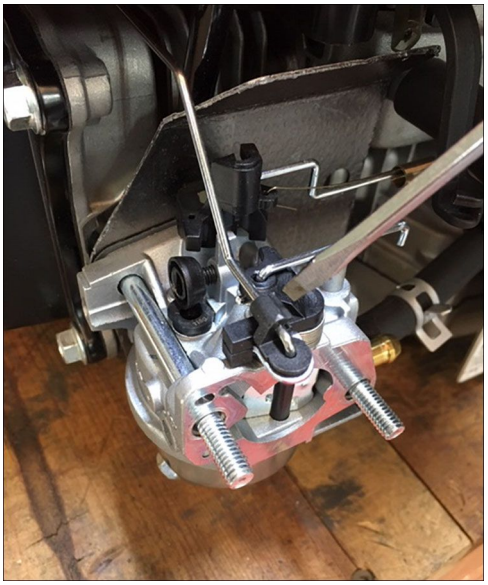

Figure 194

14. Remove the governor linkage from the governor arm by pivoting the arm towards the front of the engine, opening the throttle wide. Then lift the governor linkage up and away from the carburetor.

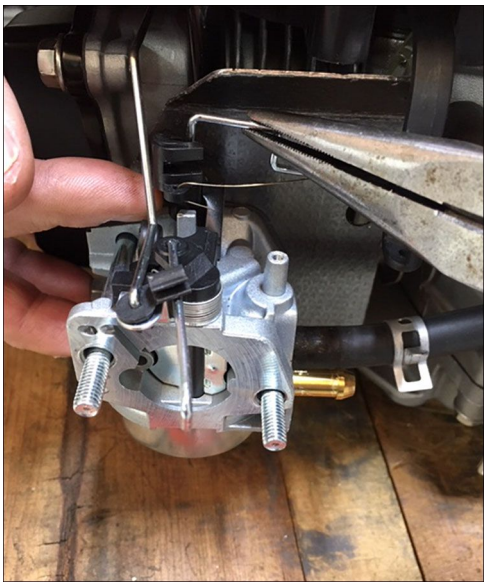

Figure 195

15. Lift upwards on the governor linkage spring and away from the carburetor.
16. Slide the carburetor away from the engine.

Figure 196

17. Remove the 2 (10 mm) nuts securing muffler to the cylinder head.

Figure 197

18. Remove the muffler cover from the muffler.
19. Remove the muffler and muffler gasket from the cylinder head.
20. Remove the spark plug wire from the spark plug.

Figure 198

21. Remove the spark plug from the cylinder head.

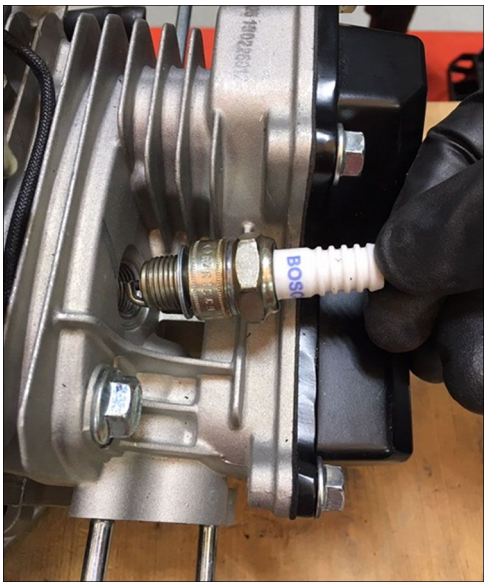

Figure 199

22. Remove the 5 (10 mm) bolts securing the valve cover to the cylinder head.

Figure 200

23. Remove the valve cover from the cylinder head.

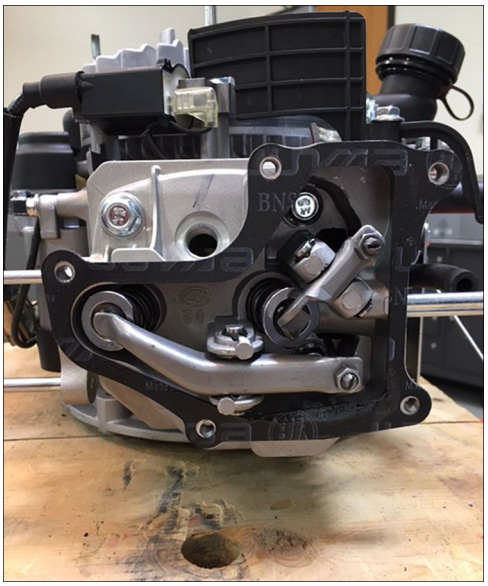

Figure 201

24. Remove the circlip from the exhaust valve rocker arm pivot pin.

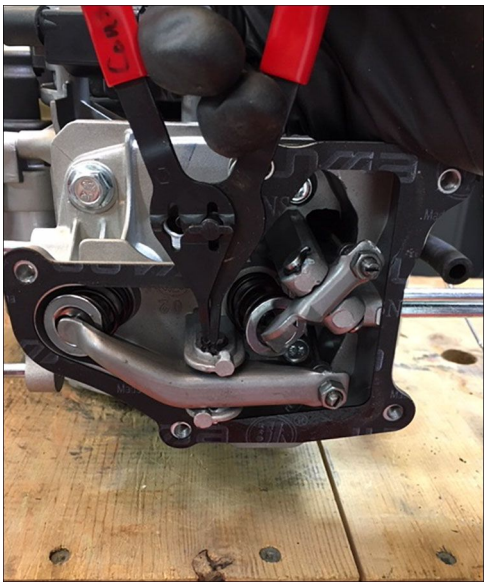

Figure 202

25. Remove the rocker arm pivot pin.

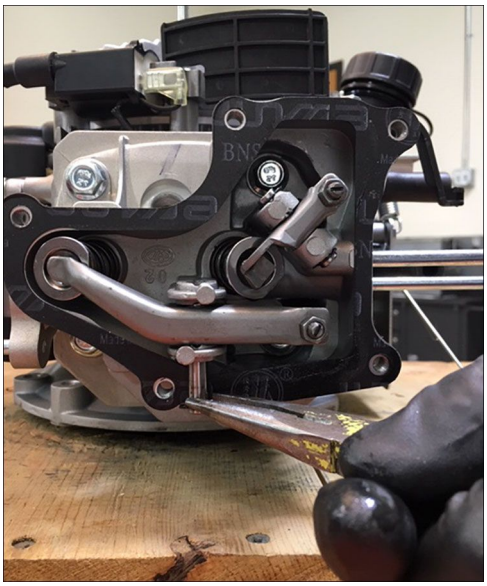

Figure 203

26. Remove the rocker arm from the cylinder head.

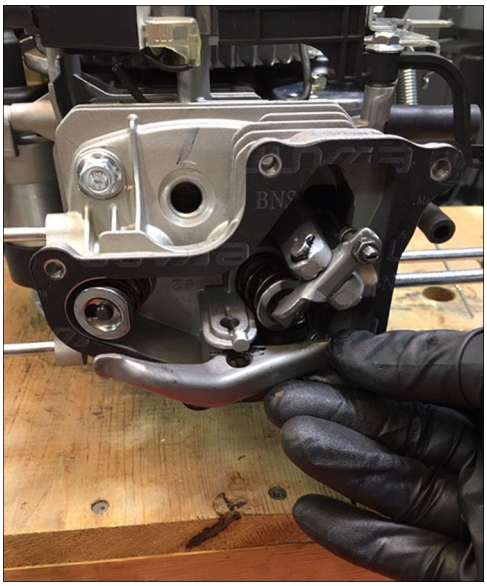

Figure 204

27. Remove the 4 (12 mm) bolts securing the cylinder head to the crankcase.

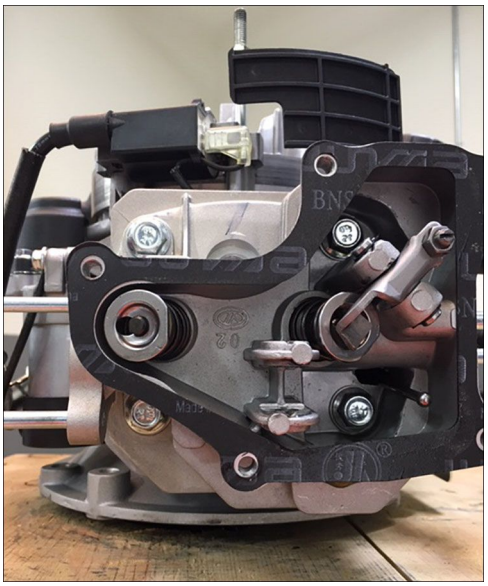

Figure 205

28. Remove the cylinder head from the crankcase.

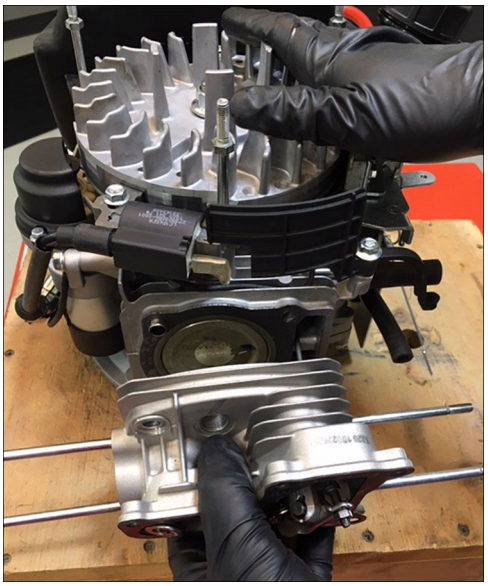

Figure 206

29. Turn the motor upside down.
30. Remove the cylinder head assembly from the engine.
31. Remove the 7 (10 mm) bolts securing the sump cover to the crankcase.

Figure 207

32. Using a soft base hammer, tap the sump cover to remove from the crankcase.

Figure 208

33. Remove the sump cover from the crankcase.

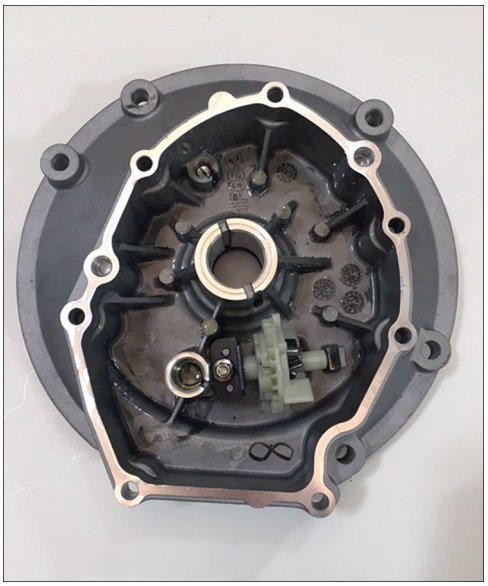

Figure 209

34. Remove the thrust washer from the crankshaft.

Figure 210

35. Turn the crankshaft clockwise, match the timing marks between the camshaft and crankshaft.

Figure 211

36. Remove the camshaft from the crankcase.
37. Remove the 2 (10 mm) connecting rod cap bolts.

Figure 212

38. Remove the connecting rod cap.

Figure 213

39. Turn the crankshaft until the piston is at the top of the stroke.

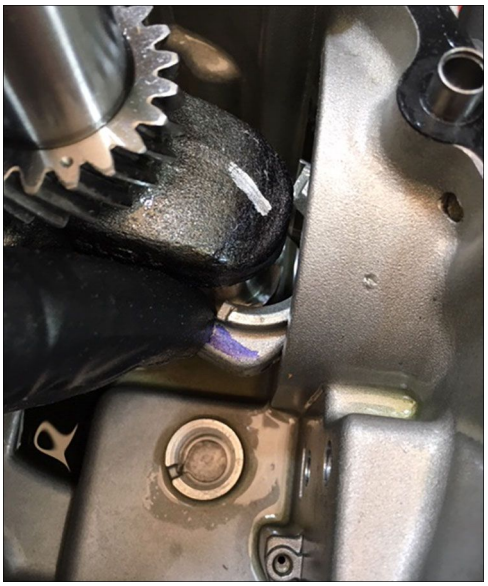

Figure 214

40. Push on the connecting rod to push the piston out of the cylinder. Remove the piston from the engine.

Piston and Rings Assembly Inspection

1. Inspect the piston for wear and scoring on the piston surface.

Figure 215

2. Remove the piston rings from the piston.

   Note: Rings shown top to bottom, left to right.

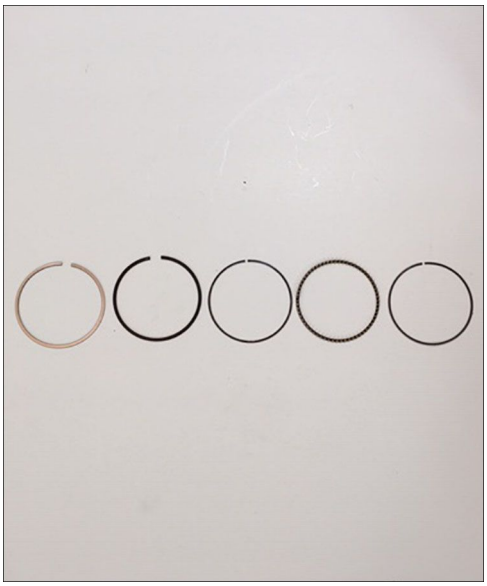

Figure 216

3. Inspect the rings for wear.

   End Gap (Top/Middle): 0.0078–0.0156 in. (0.2–0.4 mm) and 0.040 in. (1.0 mm)

   Width (Top/Middle): 0.0397 in. (1.0 mm) and 0.0342 in. (0.87 mm)

   Width (Oil Ring): 0.098 in. (2.5 mm) and 0.093 in. (2.37 mm)
4. Remove the wrist pin circlip from the piston.
5. Remove the wrist pin from the piston.
6. Measure the outside diameter of the piston.

   Skirt Outside Diameter: 2.558 in. (64.985 mm)

Piston and Rings Assembly Inspection (continued)

Service Limit: 2.552 in. (64.845 mm)

7. Measure the inside diameter of the piston.

   Sleeve Inside Diameter: 2.559 in. (65 mm)

   Service Limit: 2.565 in. (65.165 mm)

8. Measure piston to cylinder clearance.

   Clearance to Cylinder: 0.00059–0.00196 in. (0.015–0.05 mm).

Piston and Rings Assembly Installation

1. Install the piston rings on the piston.
2. Install the piston into the cylinder.

Figure 217

3. Turn the crankshaft until the piston is at the top of the stroke.

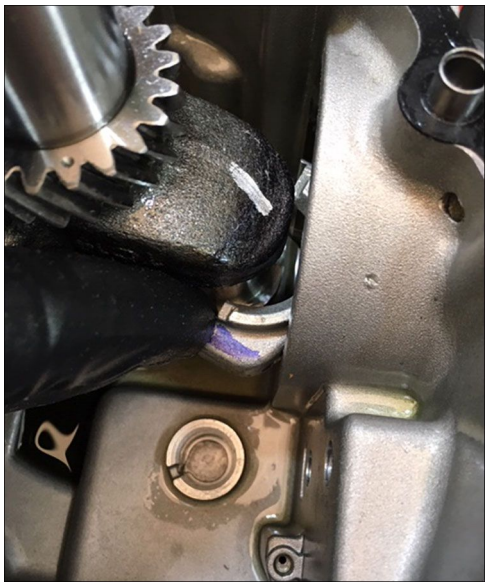

Figure 218

4. Install the connecting rod cap.

Figure 219

5. Install the 2 (10 mm) connecting rod cap bolts. Torque bolts to 108–132 in-lbs. (13–15 Nm).

Figure 220

6. Install the camshaft to the crankcase.
7. Verify the camshaft and crankshaft timing marks match.

Figure 221

8. Install the thrust washer onto the crankshaft.

Figure 222

9. Install the sump cover to the crankcase. Secure the crankcase with 7 (10 mm) bolts. Torque the bolts to 70–105 in-lbs. (8–12 Nm).

Figure 223

10. Install the cylinder head to the crankcase.

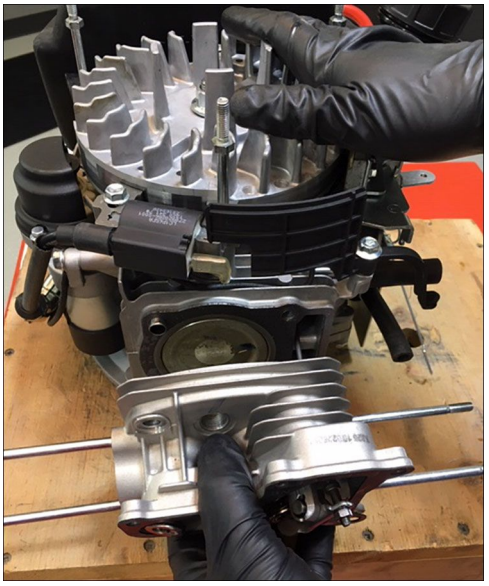

Figure 224

11. Install the 4 (12 mm) bolts securing the cylinder head to the crankcase. Torque bolts to 22–26 ft-lbs. (30–36 Nm).

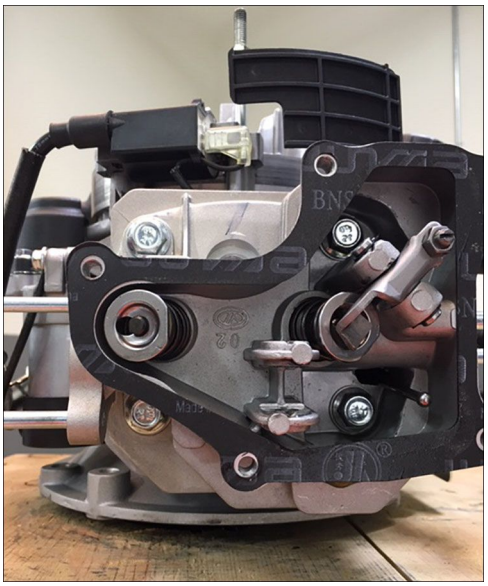

Figure 225

12. Install the rocker arm to the cylinder head.

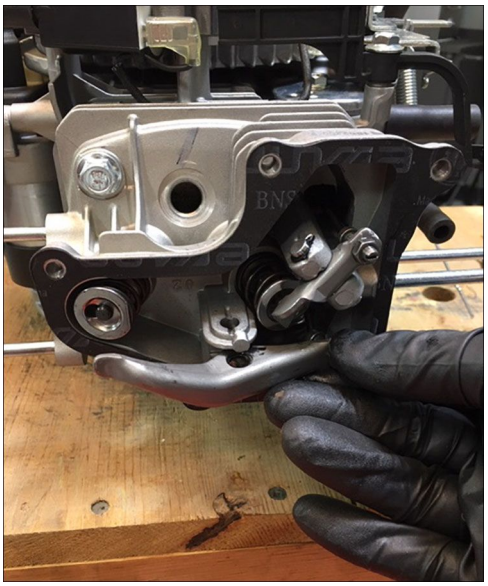

Figure 226

13. Install the rocker arm pivot pin.

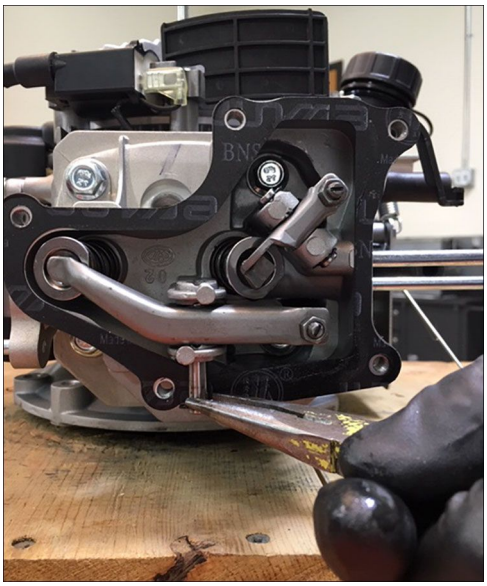

Figure 227

14. Install the circlip to the exhaust valve rocker arm pivot pin.

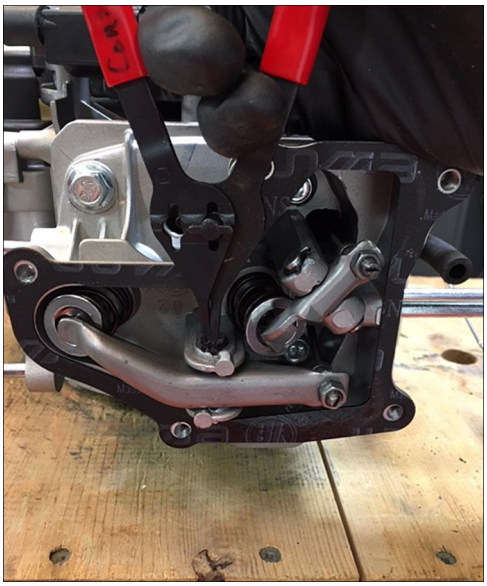

Figure 228

15. Install the valve cover to the cylinder head.

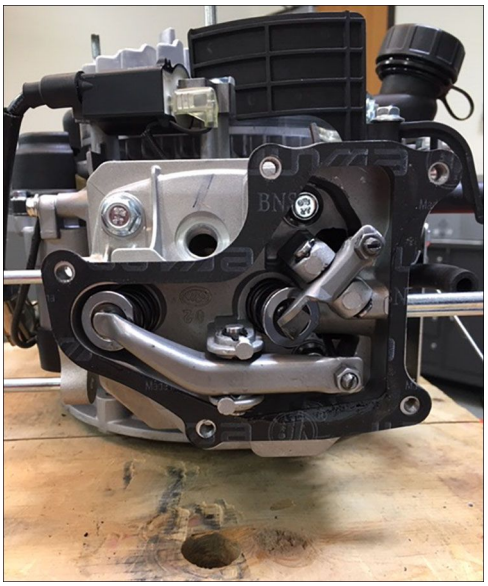

Figure 229

16. Install the 5 (10 mm) bolts securing the valve cover to the cylinder head. Torque bolts to 72 in-lbs. (8 Nm).

Figure 230

17. Install the spark plug to the cylinder head.

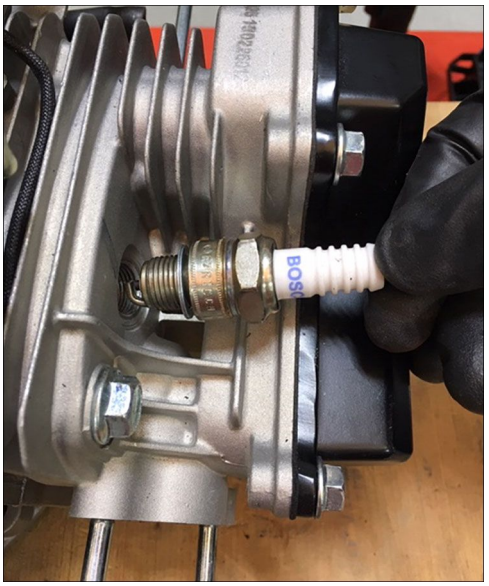

Figure 231

18. Install the spark plug wire to the spark plug. Torque the spark plug to 22 ft-lbs.(30 Nm).

Figure 232

19. Install the muffler and muffler gasket to the cylinder head.
20. Install the muffler cover to the muffler.

21. Install the 2 (10 mm) nuts securing the muffler to the cylinder head. Torque nuts to 70–105 in-lbs. (8–12 Nm).

Figure 233

22. Slide the carburetor into position on the engine.

Figure 234

23. Install the governor linkage spring.
24. Install the governor linkage onto the governor arm.

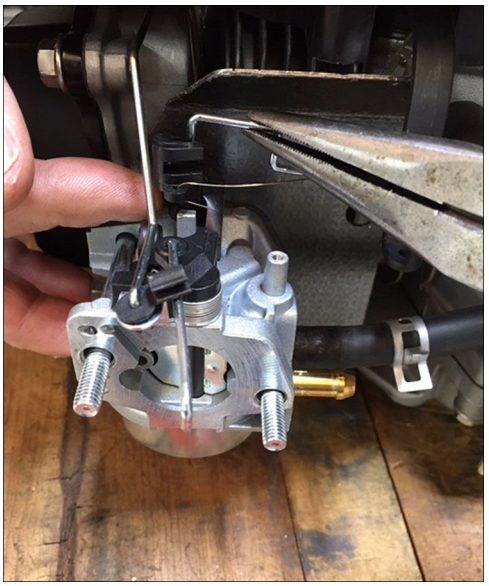

Figure 235

25. Install the thermal control linkage to the carburetor by hooking the linkage retainer inward.

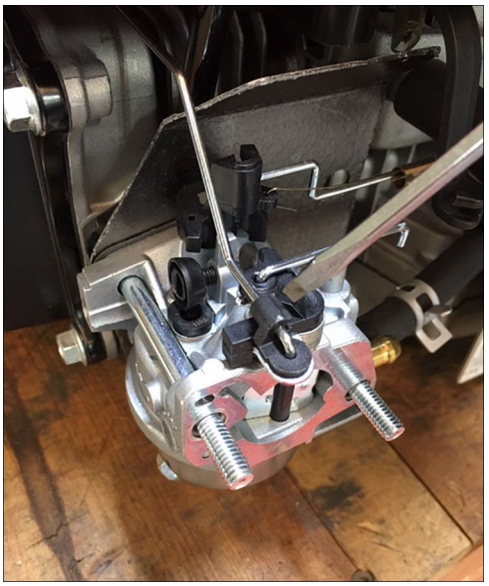

Figure 236

26. Install the linkage connecting the air vein to the carburetor.

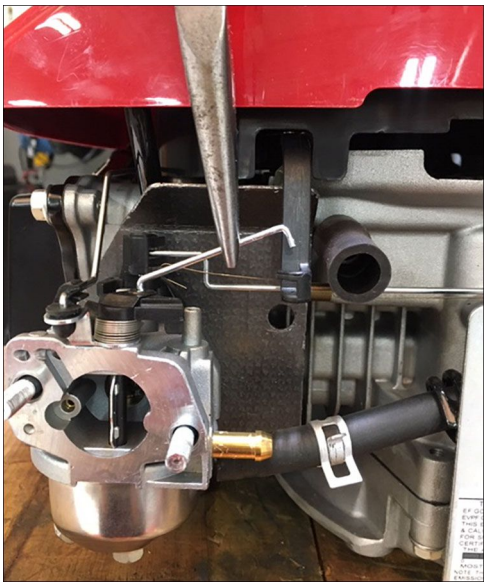

Figure 237

27. Install the fuel hose to the carburetor.

Figure 238

28. Tighten the hose clamp on the fuel hose.

29. Install the air filter housing to the engine. Secure with 2 (10 mm) nuts securing the air filter housing to the engine. Torque nuts to 52–87 in-lbs. (6–10 Nm).

Figure 239

30. Install the air filter into the air filter housing.

Figure 240

31. Install the cover to the air filter housing assembly.
32. Hinge the air filter cover upward and lock into place.
33. Install the shroud onto the engine.
34. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

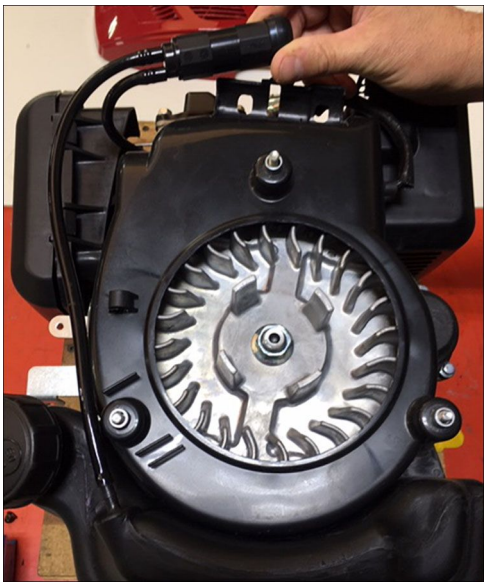

Figure 241

35. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 in-lbs. (6–10 Nm).

Figure 242

36. Turn the motor over.
37. Add oil to the engine.

Valve Adjustment

Valve Adjustment Removal

1. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 243

2. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

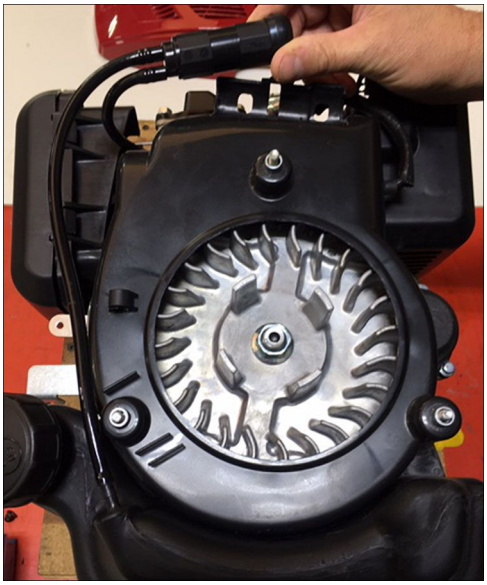

Figure 244

3. Remove the shroud by lifting away from the engine.
4. Remove the spark plug wire from the spark plug.

Figure 245

5. Remove the spark plug from the cylinder head.

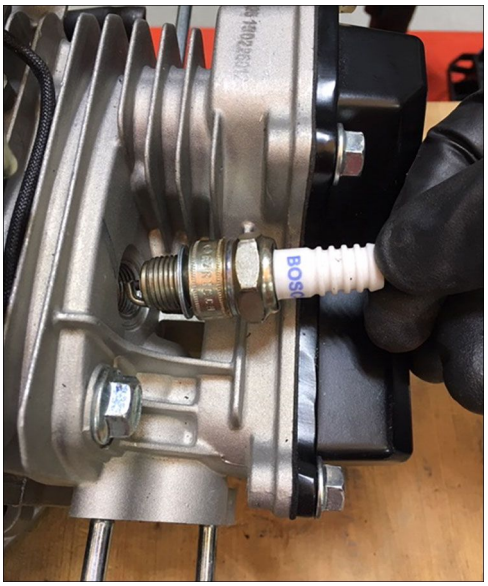

Figure 246

6. Remove the 5 (10 mm) bolts securing the valve cover to the cylinder head.

Figure 247

7. Remove the valve cover from the cylinder head.

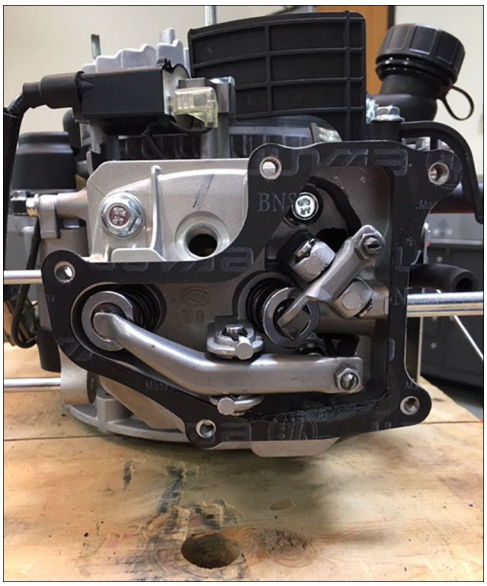

Figure 248

8. Place the piston at the top of the compression stroke to check the piston's location.
9. Place a wooden dowel in the spark plug hole and rotate the crankshaft until the piston is at the top of the compression stroke.

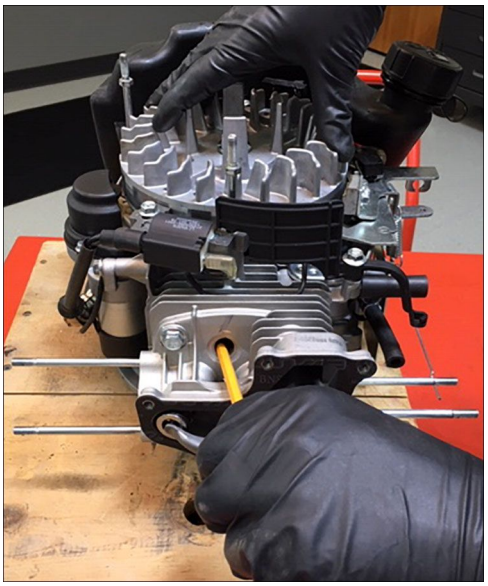

Figure 249

10. Using a feeler gauge, check clearance between the rocker arm and the top of the valve stem for the intake and exhaust valves.

    Note: The left valve is the intake and the right valve is exhaust.

    Clearance for (Cold) Intake: 0.004-0.006 in. (0.10-0.15 mm)

    Clearance for (Cold) Exhaust: 0.006-0.008 in. (0.15-0.20 mm)

Figure 250

Valve Adjustment Removal (continued)

Figure 251

11. To make an adjustment, place a flat blade screwdriver in the slot of the adjusting screw. Loosen the lock nut using a 10 mm wrench. Turn the adjusting screw in or out to adjust the gap between the rocker arm and valve stem. When the clearance is correct, tighten the lock nut and recheck the clearance.

Valve Adjustment Installation

1. Install the valve cover onto the cylinder head.

2. Install the 5 (10 mm) bolts securing the valve cover to the cylinder head. Torque bolts to 57–87 ft-lbs. (6–10 Nm).

Figure 252

3. Install the spark plug to the cylinder head. Torque the spark plug to 22 ft-lbs. (30 Nm)

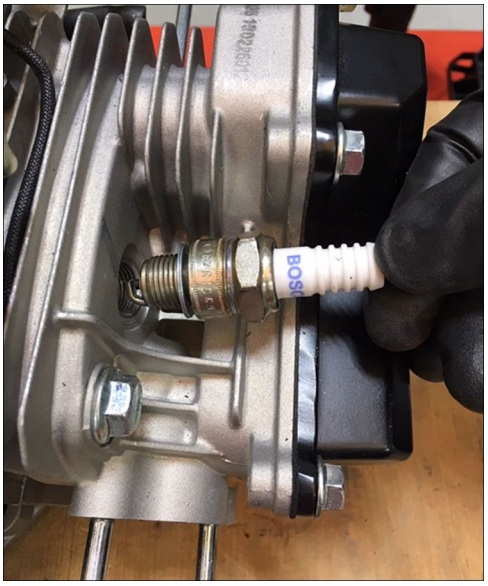

Figure 253

4. Install the spark plug wire to the spark plug.

Figure 254

5. Install the shroud onto the engine.
6. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

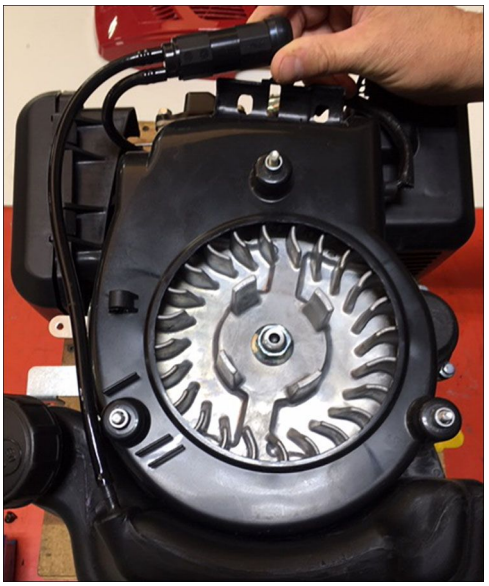

Figure 255

7. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 ft-lbs. (6–10 Nm).

Figure 256

Chapter 8

Electrical System

Table of Contents

General Information

This chapter covers the disassembly, inspection, testing, and assembly of the electrical system.

Service and Repairs

Electrical System Assembly

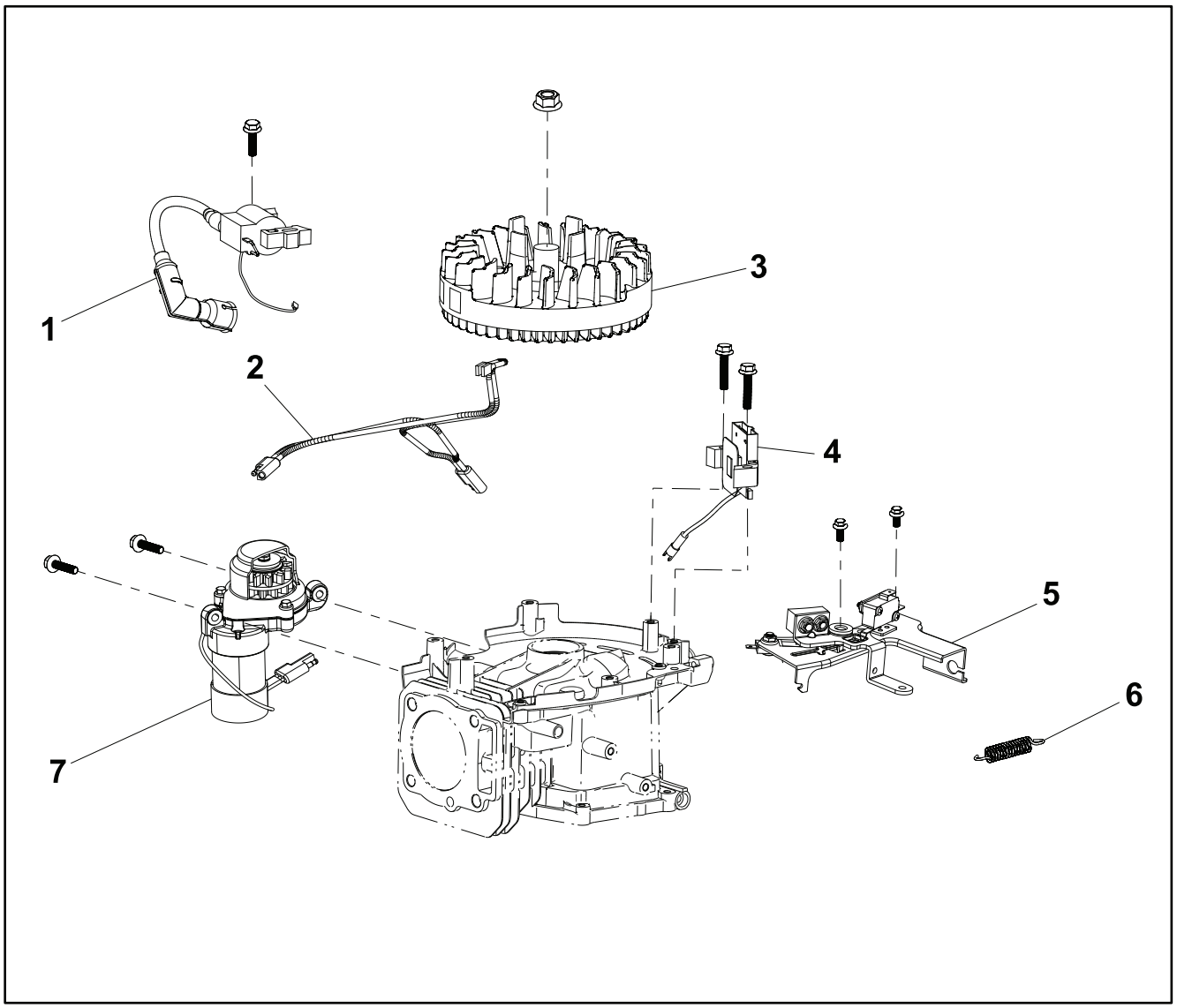

Figure 257

1. Ignition Coil Asm.
2. Starter Motor Harness
3. Flywheel
4. Alternator
5. Brake Asm.
6. Brake Spring
7. Starter Motor

Electric Starter Replacement

Electric Starter Removal

1. Unplug the electric starter from the mower harness.

Figure 258

2. Remove the 2 starter mounting bolts securing the starter to the engine.

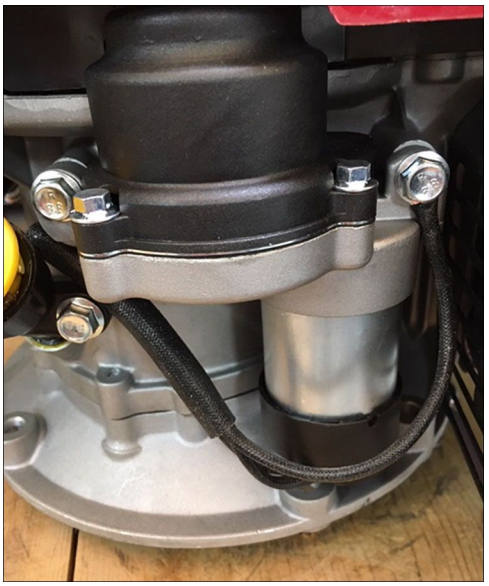

Figure 259

3. Remove the starter from the engine.

Electric Starter Removal (continued)

Figure 260

Electric Starter Installation

1. Install the starter onto the engine.

Figure 261

2. Loosely install the left hand mounting bolt securing the starter to the engine.

3. While installing the right hand mounting bolt, install the bolt through eyelet of the ground wire. Torque the mounting bolts to 90 in-lbs. (10 Nm).

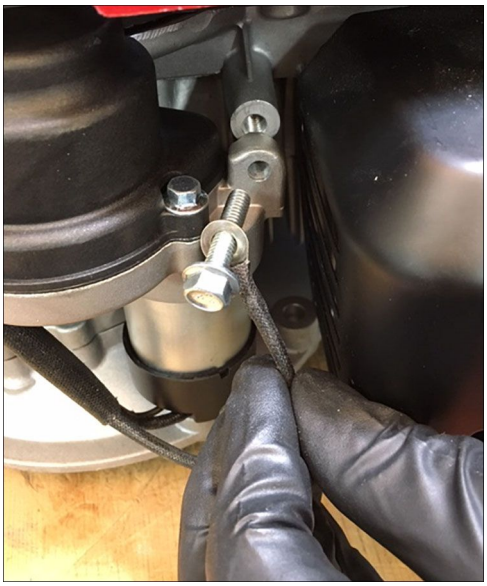

Figure 262

4. Plug the electric starter into the mower harness.

Figure 263

Ignition Coils Replacement

Ignition Coils Removal

1. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 264

2. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

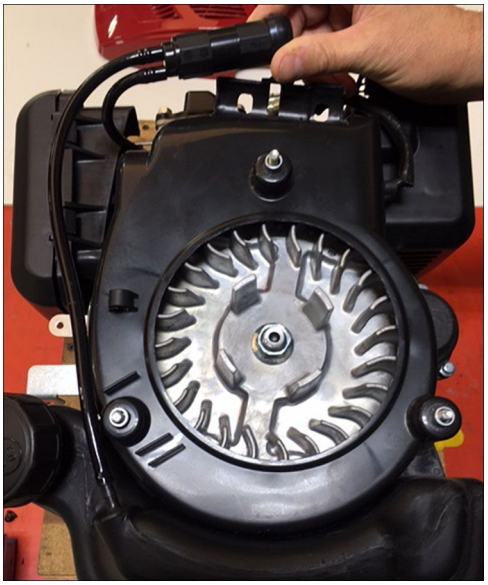

Figure 265

3. Remove the shroud by lifting away from the engine.
4. Unplug the ground wire from the connector at the brake assembly.

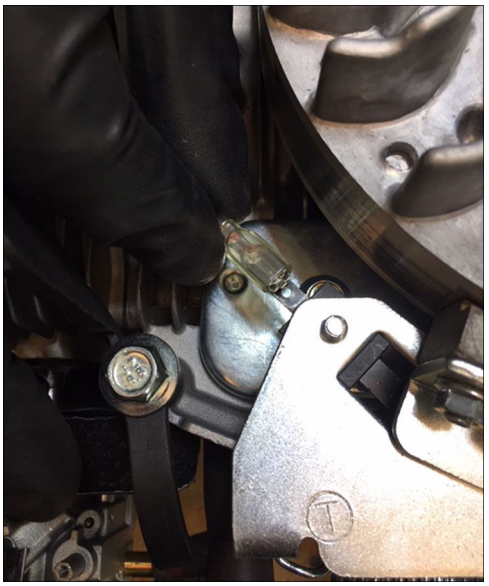

Figure 266

5. Remove the spark plug wire from the spark plug.

Figure 267

6. Remove the coil mounting bolt and shroud mounting stud from the coil.

Ignition Coils Removal (continued)

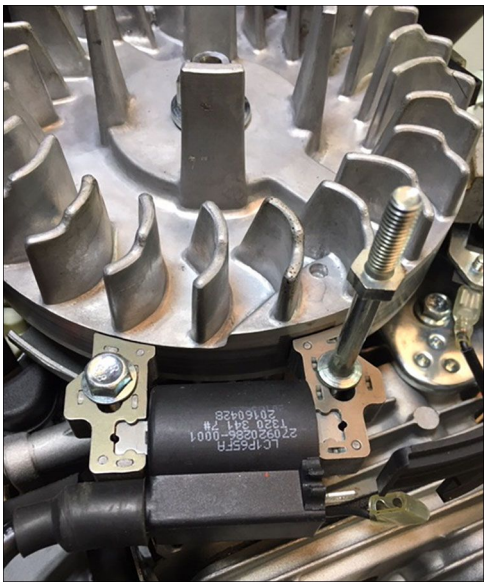

Figure 268

7. Remove the ignition coil from the engine.

Figure 269

Ignition Coil Resistance Test

Primary

1. Place one lead on the coil connector.
2. Place one lead on the coil frame.

Figure 270

3. The volt Ohm meter should read 1.3-1.7 Ohms.

Secondary

1. Remove the spark plug cap from the high tension wire by holding the wire and unscrewing the cap by turning counter-clockwise.
2. Place one lead of the meter in the end of the high tension lead.

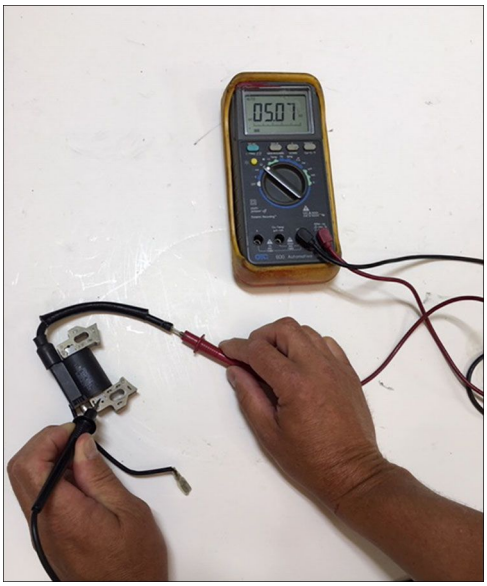

Figure 271

3. Place the other lead on the coil frame.
4. The volt Ohm meter should read 5.4-6.2 Ohms.

Ignition Coil Installation

1. Install the ignition coil onto the engine.

Figure 272

2. Install the coil mounting bolt and shroud mounting stud onto the coil. Torque the bolt and stud to 90 in-lbs. (10 Nm).

   Set air gap: 0.0157-0.007 in (0.4-0.2 mm)

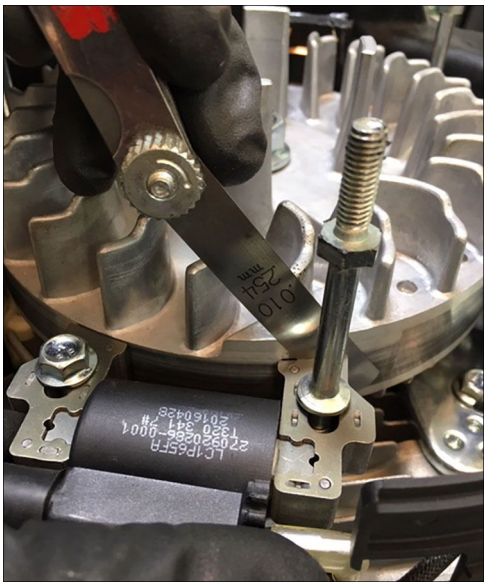

Figure 273

3. Install the spark plug wire to the spark plug.

Figure 274

4. Install the shroud onto the engine.
5. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

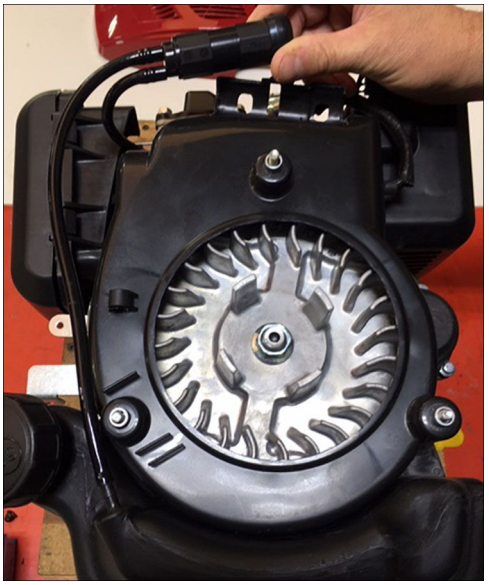

Figure 275

6. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 ft-lbs. (6–10 Nm).

Figure 276

Spark Plugs Replacement

Spark Plug Removal

1. Remove the spark plug cap.

Figure 277

2. Remove the spark plug from the cylinder head.

Spark Plug Removal (continued)

Figure 278

Spark Plug Inspection

1. Inspect the spark plug condition for carbon or oil build-up. Replace as necessary.

Figure 279

2. Check the spark plug gap.

   Gap: 0.30 in. (0.7–0.8 mm)

Spark Plug Inspection (continued)

Figure 280

Spark Plug Installation

1. Screw the spark plug into the cylinder head. Torque screw to 22 ft-lbs. (30 Nm).

Figure 281

2. Install the spark plug cap.

Figure 282

Charging System Replacement

Charging System Removal

1. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 283

2. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

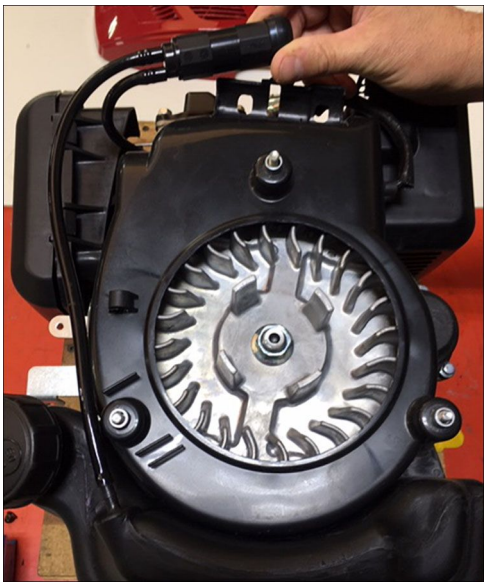

Figure 284

3. Remove the shroud by lifting away from the engine.
4. Drain the fuel tank.
5. Loosen the hose clamp on the fuel hose.
6. Remove the fuel hose from the fuel tank fitting.
7. Remove the 2 shroud mounting studs securing the fuel tank to the crankcase.

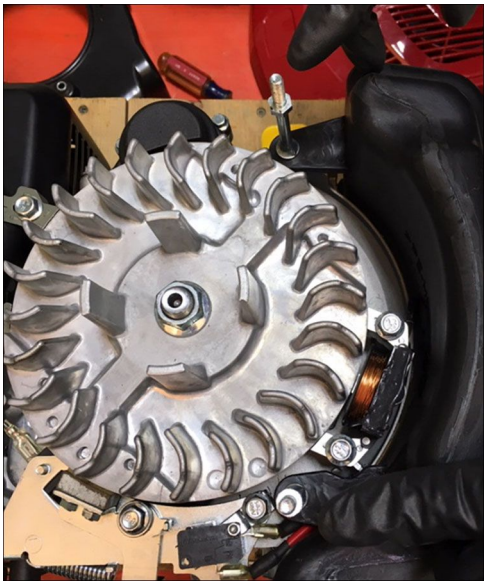

Figure 285

8. Remove the 10 mm nut and washer from the fuel tank mounting stud.

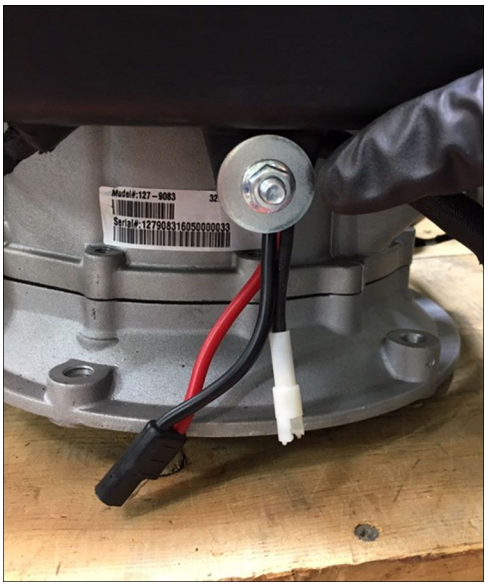

Figure 286

9. Remove the fuel tank from the engine.
10. Remove the 2 (10 mm) mounting bolts securing the charge coil to the crankcase.

Figure 287

11. Remove the charge coil from the crankcase.

Alternator Test

1. Make sure the battery is fully charged.
2. Place the positive test lead from the volt meter to the positive terminal on the mower battery.
3. Place the negative test lead from the volt meter to the negative test lead on the battery.
4. Start the engine. Check the battery voltage. Voltage specification should be 13.2–16.2 VDC.

Charging System Installation

1. Install the charge coil to the crankcase.

2. Install the 2 (10 mm) mounting bolts securing the charge coil to the crankcase. Torque bolts to 90 in-lbs. (10 Nm). Set air gap to:

   Air Gap: 0.0157 ± 3.007 in. (0.4–0.2 mm)

Figure 288

---

3. Install the fuel tank to the engine.

4. Install the 10 mm nut and washer to the fuel tank mounting stud. Torque nut and washer to 90 in-lbs. (10 Nm).

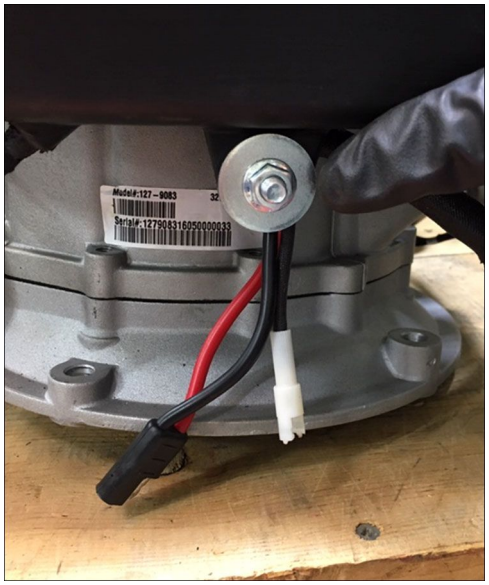

Figure 289

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5. Install the 2 shroud mounting studs securing the fuel tank to the crankcase. Torque studs to 70–105 in-lbs. (8–12 Nm).

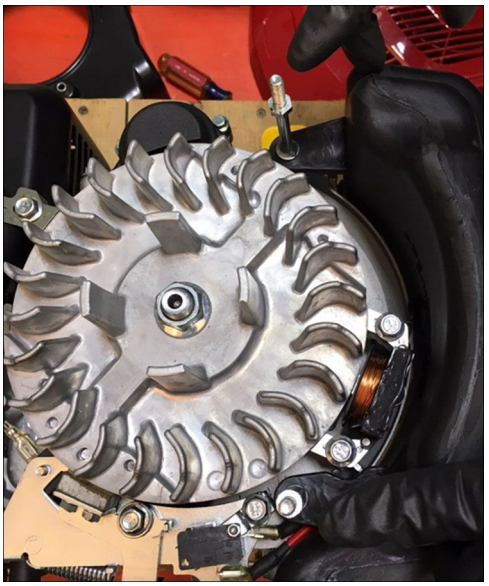

Figure 290

6. Install the fuel hose to the fuel tank fitting.
7. Tighten the hose clamp on the fuel hose.
8. Add fuel to the fuel tank.
9. Install the shroud onto the engine.
10. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

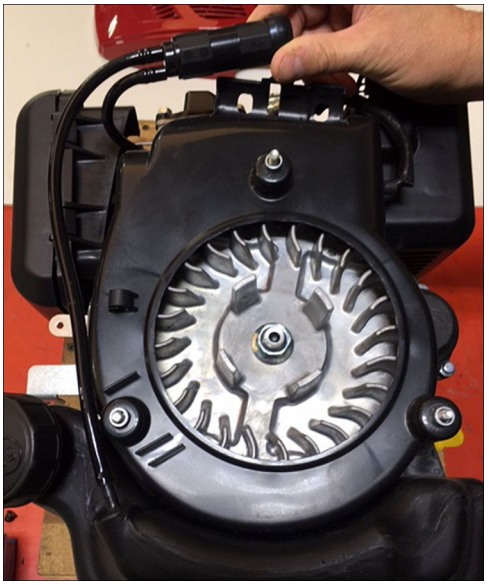

Figure 291

11. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 ft-lbs. (6–10 Nm).

Figure 292

Chapter 9

Engine Lower End

Table of Contents

General Information

This chapter covers the disassembly, inspection, and assembly of the crankshaft, camshaft, and governor system.

Service and Repairs

Engine Lower End Assembly

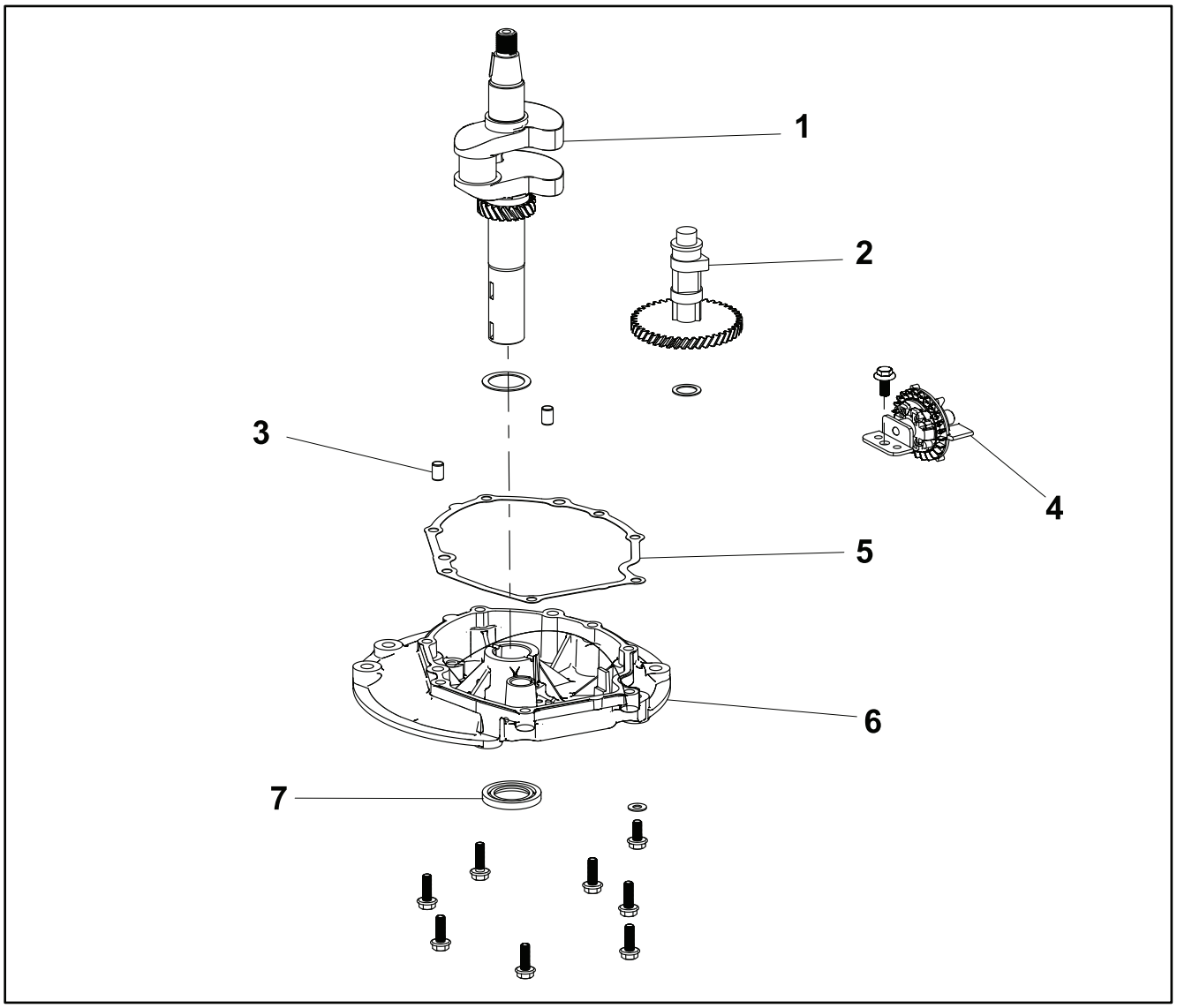

Figure 293

1. Crankshaft Asm.
2. Camshaft Asm.
3. Dowel Pin
4. Governor Gear Asm.
5. Case Gasket Cover
6. Crankcase Cover
7. Oil Seal

Sump Cover Replacement

Sump Cover Removal

1. Drain the oil.
2. Turn the motor upside down.
3. Remove the 7 (10 mm) bolts securing the sump cover to the crankcase.

Figure 294

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4. Using a soft base hammer, tap the sump cover to remove from the crankcase.

Figure 295

---

5. Remove the sump cover from the crankcase.

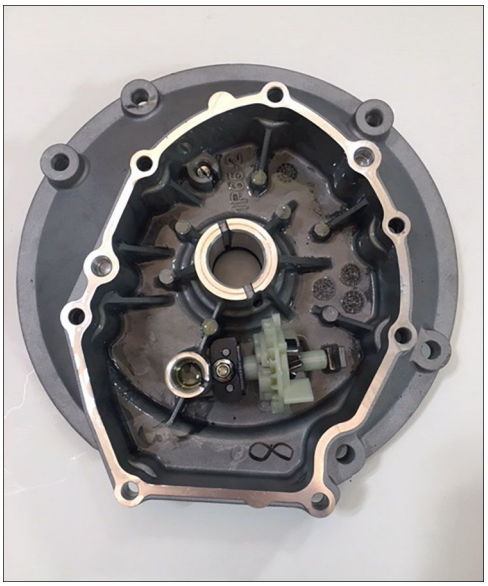

Figure 296

Sump Cover Installation

1. Install the sump cover to the crankcase. Secure the crankcase with 7 (10 mm) bolts. Torque the bolts to 70–105 in-lbs. (8–12 Nm).

Figure 297

2. Turn the motor over.
3. Add oil to the engine.

Governor Assembly Replacement

Governor Assembly Removal

1. Drain the oil.

2. Turn the motor upside down.
3. Remove the 7 (10 mm) bolts securing the sump cover to the crankcase.

Figure 298

4. Using a soft base hammer, tap the sump cover to remove from the crankcase.

Figure 299

5. Remove the sump cover from the crankcase.

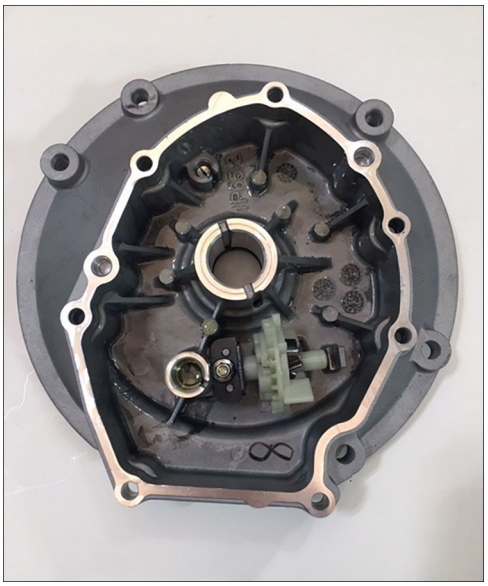

Figure 300

6. Remove the thrust washer from the crankshaft.

Figure 301

7. Turn the crankshaft clockwise, match the timing marks between the camshaft and crankshaft.

Figure 302

8. Remove the camshaft from the crankcase.
9. Loosen the (10 mm) nut from the governor arm bolt.

Figure 303

10. Remove the governor spring from the governor arm. Note the position of the governor spring.

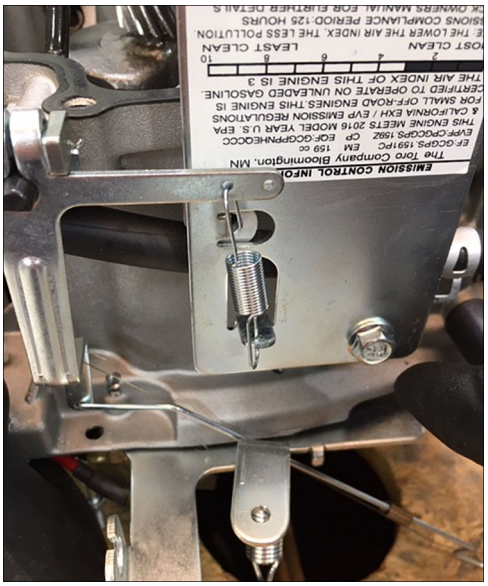

Figure 304

11. Remove the governor arm from the governor shaft.

Figure 305

12. Remove the hair pin from the governor shaft.

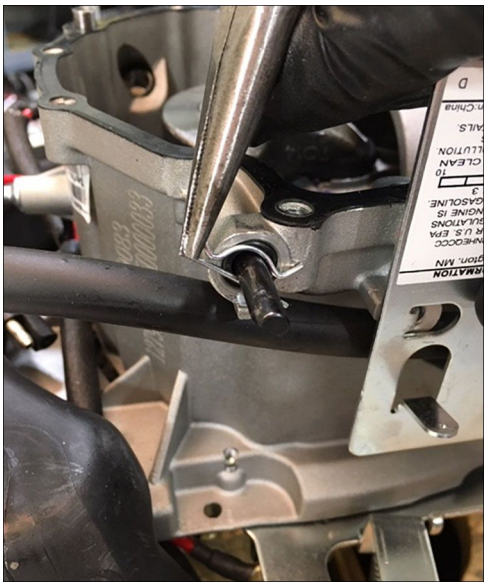

Figure 306

13. Slide the governor arm from the crankcase.

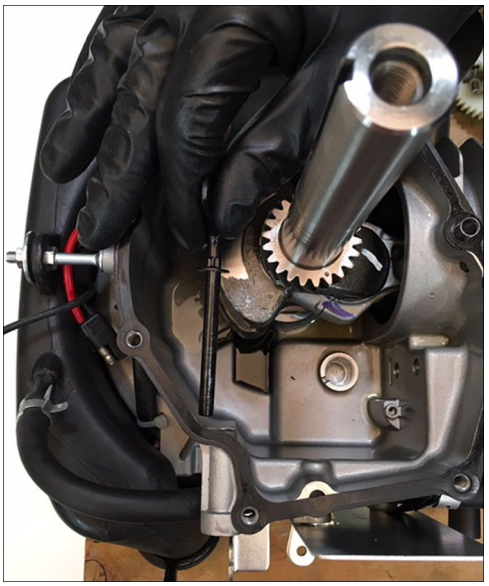

Figure 307

14. Remove the (8 mm) bolt securing the governor gear to the sump cover.

Governor Assembly Removal (continued)

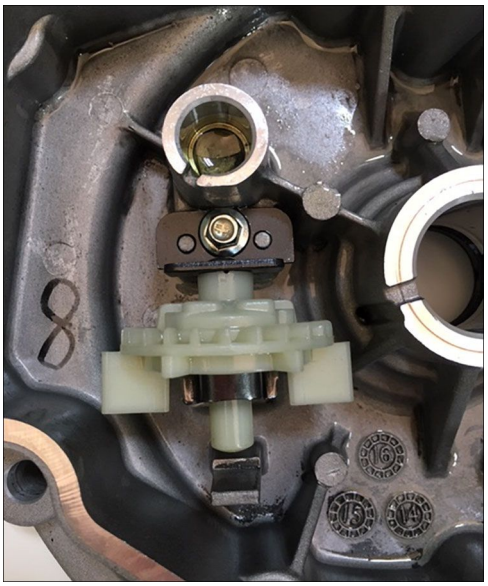

Figure 308

15. Remove the governor gear from the sump cover.

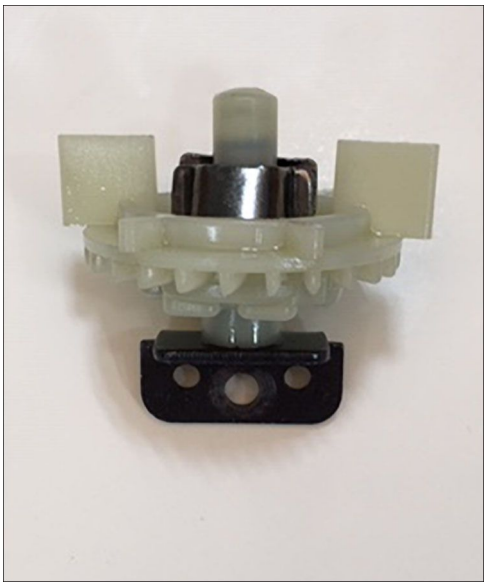

Figure 309

Governor Assembly Inspection

1. Inspect the fly weights for wear or damage.

Figure 310

2. Remove the plunger and thrust washer. Inspect for wear or damage and verify the plunger moves freely on the governor gear shaft.

Figure 311

3. Inspect the teeth for wear or damage.

Governor Assembly Inspection (continued)

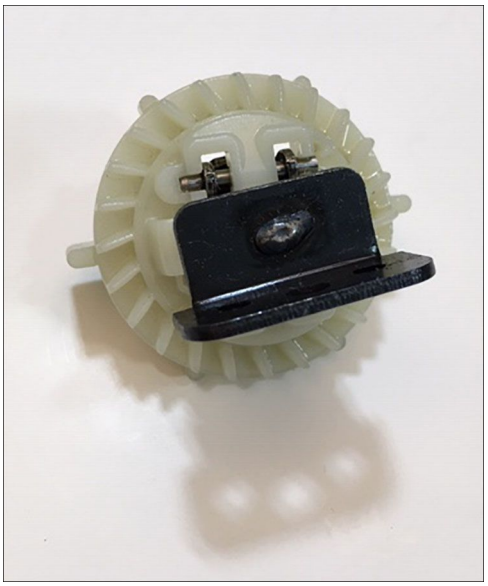

Figure 312

Governor Assembly Installation

1. Install the governor gear to the sump cover.

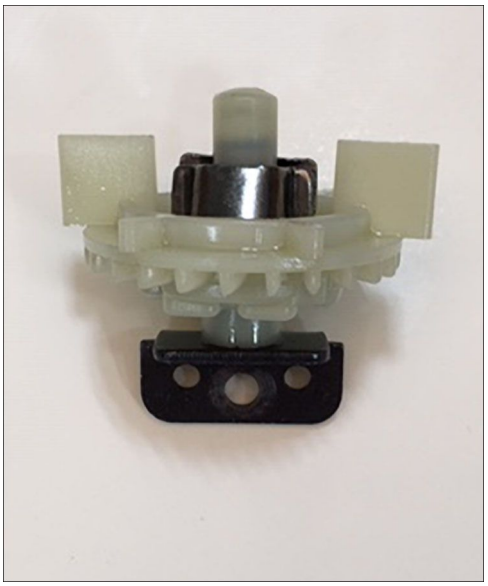

Figure 313

2. Install the 8 mm bolt securing the governor gear to the sump cover.

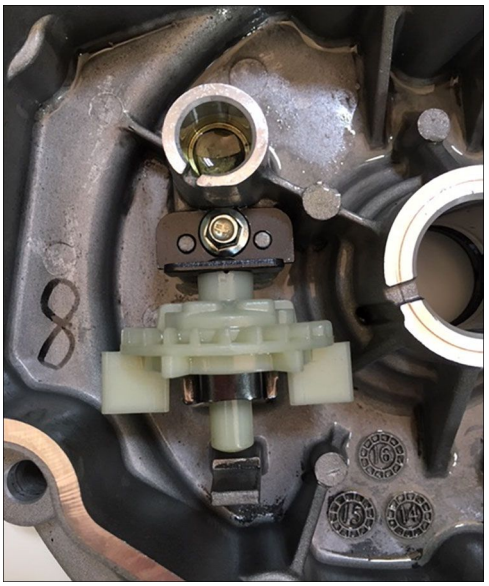

Figure 314

3. Slide the governor arm to the crankcase.

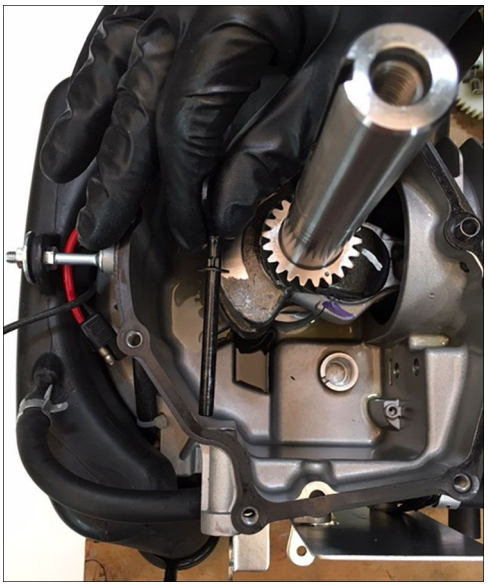

Figure 315

4. Install the hair pin to the governor shaft.

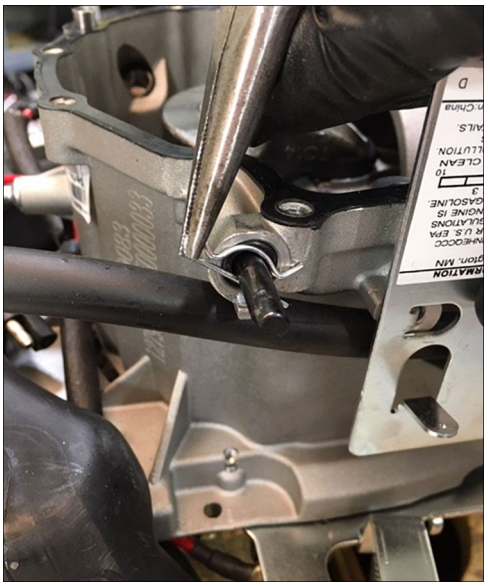

Figure 316

5. Install the governor arm to the governor shaft.

Figure 317

6. Install the governor spring to the governor arm. Note the position of the governor spring.

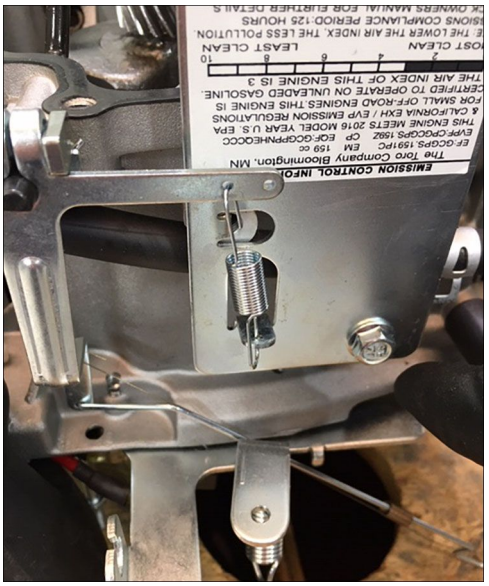

Figure 318

7. Tighten the (10 mm) nut to the governor arm bolt. Torque nut to 90 in-lbs. (10 Nm).

Figure 319

8. Install the camshaft to the crankcase.
9. Verify the camshaft and crankshaft timing marks match.

Figure 320

10. Install the thrust washer onto the crankshaft.

Figure 321

Governor Assembly Installation (continued)

11. Install the sump cover to the crankcase. Secure the crankcase with 7 (10 mm) bolts. Torque the bolts to 70–105 in-lbs. (8–12 Nm).

Figure 322

---

12. Turn the motor over.
13. Zero the governor.

Zeroing the Governor

1. Move the governor arm so the throttle plate at the carburetor is wide open.
2. Loosen the pinch bolt on the governor arm.
3. Using pliers, turn the governor shaft clockwise until it stops.
4. Tighten the pinch bolt.

Crankshaft Replacement

Crankshaft Removal

1. Drain the oil.
2. Remove the 3 (10 mm) acorn nuts securing the recoil assembly to the top of the engine. Remove the recoil assembly.

Figure 323

3. Remove the fuel tank vent hose from the hose retainer on the engine shroud. Move the carbon canister to the side of the engine.

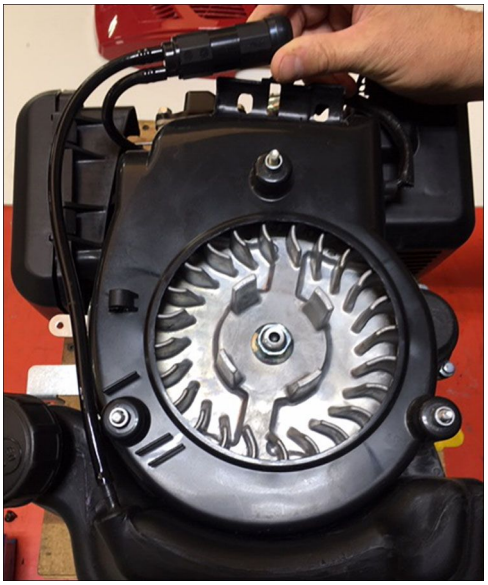

Figure 324

4. Remove the shroud by lifting away from the engine.
5. Loosen the nut securing the crankshaft to the engine.
6. Unhook the spring from the brake mechanism.

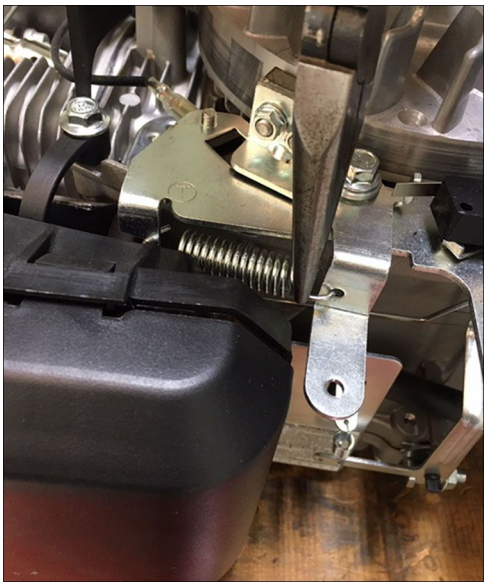

Figure 325

7. Place a pry bar under the flywheel to pry the flywheel upwards. Use a soft based hammer, to loosen the flywheel assembly from crankshaft, only striking the top of the nut to prevent crankshaft damage.

Figure 326

8. Remove the nut from the crankshaft. Remove the flywheel from the engine.

Figure 327

9. Turn the motor upside down.
10. Remove the cylinder head assembly from the engine.
11. Remove the 7 (10 mm) bolts securing the sump cover to the crankcase.

Figure 328

12. Using a soft base hammer, tap the sump cover to remove from the crankcase.

Figure 329

13. Remove the sump cover from the crankcase.

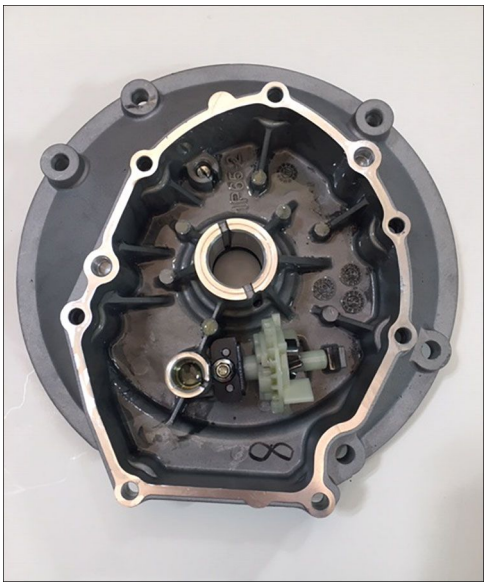

Figure 330

14. Remove the thrust washer from the crankshaft.

Figure 331

15. Turn the crankshaft clockwise, match the timing marks between the camshaft and crankshaft.

Figure 332

16. Remove the camshaft from the crankcase.
17. Remove the 2 (10 mm) connecting rod cap bolts.

Figure 333

18. Remove the connecting rod cap.

Figure 334

19. Remove the connecting rod and piston.

Figure 335

20. Remove the flywheel key from the crankshaft.

Figure 336

Crankshaft Inspection

1. Inspect the connecting rod journal and crankcase bearing surfaces for damage or scoring.
2. Check to specifications.

   Crankshaft Connecting Rod Journal Outside Diameter: 1.022 in. (25.98 mm)

   Service Limit: 1.020 in. (25.392 mm)

Crankshaft Installation

1. Install the flywheel key to the crankshaft.

Figure 337

2. Install the connecting rod and piston.

Figure 338

3. Install the connecting rod cap.

Figure 339

4. Install the 2 (10 mm) connecting rod cap bolts. Torque bolts to 108–132 in-lbs. (13–15 Nm).

Figure 340

5. Install the camshaft to the crankcase.
6. Verify the camshaft and crankshaft timing marks match.

Figure 341

7. Install the thrust washer onto the crankshaft.

Figure 342

8. Install the sump cover to the crankcase. Secure the crankcase with 7 (10 mm) bolts. Torque the bolts to 70–105 in-lbs. (8–12 Nm).

Figure 343

9. Turn the motor over.
10. Install the flywheel onto the engine.

Figure 344

11. Install the nut securing the crankshaft to the flywheel. Torque nut to 59–66 ft-lbs. (80–90 Nm).
12. Hook the spring to the brake mechanism.

Figure 345

13. Install the shroud onto the engine.
14. Place the carbon canister into position on the engine. Install the fuel tank vent hose to the hose retainer on the engine shroud.

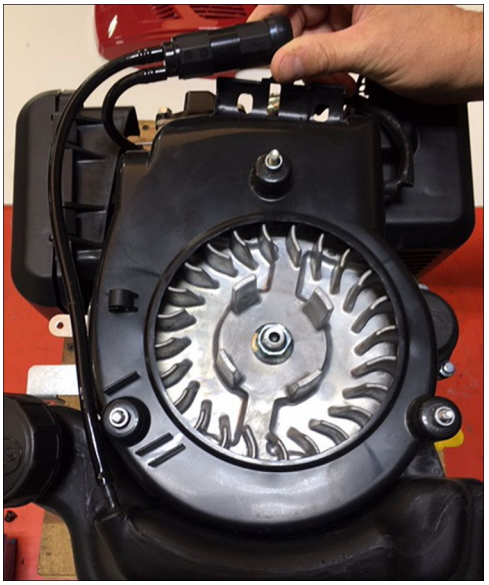

Figure 346

15. Install the recoil assembly onto the engine. Secure with 3 (10 mm) acorn nuts. Torque acorn nuts to 52–87 ft-lbs. (6–10 Nm).

Figure 347

16. Add oil to the engine.

Camshaft Replacement

Camshaft Removal

1. Drain the oil.
2. Turn the motor upside down.
3. Remove the 7 (10 mm) bolts securing the sump cover to the crankcase.

Figure 348

4. Using a soft base hammer, tap the sump cover to remove from the crankcase.

Figure 349

5. Remove the sump cover from the crankcase.

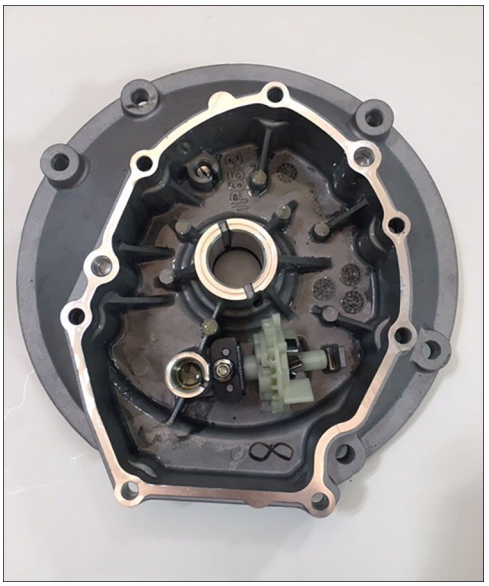

Figure 350

6. Remove the thrust washer from the crankshaft.

Figure 351

7. Turn the crankshaft clockwise, match the timing marks between the camshaft and crankshaft.

Figure 352

8. Remove the camshaft from the crankcase.

Camshaft Inspection

1. Inspect the cam lobes for wear.

Figure 353

2. Inspect the automatic compression release for damage and functionality.

Figure 354

3. Remove the tappets from the crankcase.

Figure 355

4. Verify the tappets move freely in the crankcase. Inspect tappet faces for wear.

Figure 356

Camshaft Installation

1. Install the camshaft to the crankcase.
2. Verify the camshaft and crankshaft timing marks match.

Figure 357

3. Install the thrust washer onto the crankshaft.

Figure 358

4. Install the sump cover to the crankcase. Secure the crankcase with 7 (10 mm) bolts. Torque the bolts to 70–105 in-lbs. (8–12 Nm).

Figure 359

5. Turn the motor over.
6. Add oil to the engine.