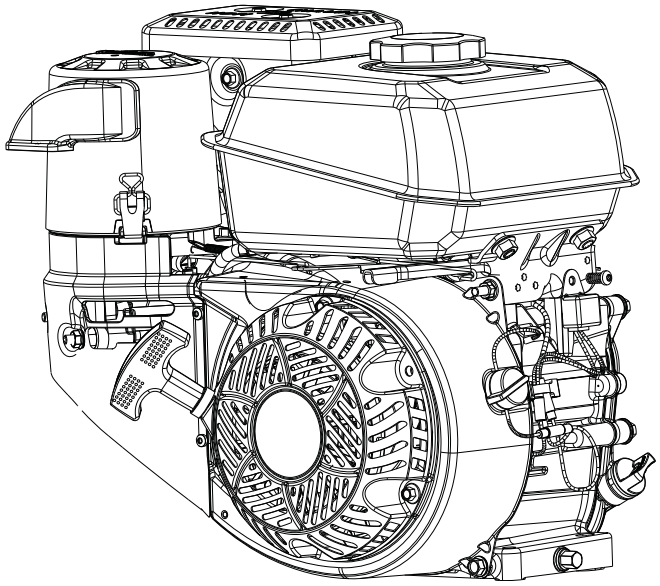
# KOHLER Command PRO

## CH260-CH440

## Service Manual



IMPORTANT: Read all safety precautions and instructions carefully before operating equipment. Refer to operating instruction of equipment that this engine powers.

Ensure engine is stopped and level before performing any maintenance or service.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# Safety

## SAFETY PRECAUTIONS

⚠ **WARNING:** A hazard that could result in death, serious injury, or substantial property damage.

⚠ **CAUTION:** A hazard that could result in minor personal injury or property damage.

NOTE: is used to notify people of important installation, operation, or maintenance information.

**⚠ WARNING**

Explosive Fuel can cause fires and severe burns.

Do not fill fuel tank while engine is hot or running.

Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Never use gasoline as a cleaning agent.

**⚠ WARNING**

Rotating Parts can cause severe injury.

Stay away while engine is in operation.

Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate engine with covers, shrouds, or guards removed.

**⚠ WARNING**

Carbon Monoxide can cause severe nausea, fainting or death.

Avoid inhaling exhaust fumes.

Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled.

**⚠ WARNING**

Accidental Starts can cause severe injury or death.

Disconnect and ground spark plug lead(s) before servicing.

Before working on engine or equipment, disable engine as follows: 1) Disconnect spark plug lead(s). 2) Disconnect negative (–) battery cable from battery.

**⚠ WARNING**

Hot Parts can cause severe burns.

Do not touch engine while operating or just after stopping.

Never operate engine with heat shields or guards removed.

**⚠ WARNING**

Cleaning Solvents can cause severe injury or death.

Use only in well ventilated areas away from ignition sources.

Carburetor cleaners and solvents are extremely flammable. Follow cleaner manufacturer's warnings and instructions on its proper and safe use. Never use gasoline as a cleaning agent.

**⚠ CAUTION**

Electrical Shock can cause injury.

Do not touch wires while engine is running.

**⚠ CAUTION**

Damaging Crankshaft and Flywheel can cause personal injury.

Using improper procedures can lead to broken fragments. Broken fragments could be thrown from engine. Always observe and use precautions and procedures when installing flywheel.

**⚠ WARNING**

Uncoiling Spring can cause severe injury.

Wear safety goggles or face protection when servicing retractable starter.

Retractable starters contain a powerful, recoil spring that is under tension. Always wear safety goggles when servicing retractable starters and carefully follow instructions in Retractable Starter for relieving spring tension.

## MAINTENANCE INSTRUCTIONS

|  | **⚠ WARNING**<br>Accidental Starts can cause severe injury or death.<br>Disconnect and ground spark plug lead(s) before servicing. | Before working on engine or equipment, disable engine as follows: 1) Disconnect spark plug lead(s). 2) Disconnect negative (–) battery cable from battery. |
|---|---|---|

Normal maintenance, replacement or repair of emission control devices and systems may be performed by any repair establishment or individual; however, warranty repairs must be performed by a Kohler authorized dealer.

## MAINTENANCE SCHEDULE

After first 5 Hours

| | |
|---|---|
| ● Change oil. | Lubrication System |

Every 50 Hours

| | |
|---|---|
| ● Change oil in 2:1 with Clutch Reduction System (CH270, CH395, CH440). | Gear Reduction System |

Every 50 Hours or Annually

| | |
|---|---|
| ● Service/replace Quad-Clean™ precleaner. | Air Cleaner/Intake |

Every 100 Hours or Annually[1]

| | |
|---|---|
| ● Clean low-profile air cleaner element. | Air Cleaner/Intake |
| ● Change oil. | Lubrication System |
| ● Clean cooling areas. | Air Cleaner/Intake |

Every 200 Hours

| | |
|---|---|
| ● Replace Quad-Clean™ air cleaner element. | Air Cleaner/Intake |

Every 300 Hours

| | |
|---|---|
| ● Replace low-profile air cleaner element. | Air Cleaner/Intake |
| ● Check fuel filters (tank outlet filter and in-line filter) clean or replace if needed (if equipped). | Fuel System |
| ● Change oil in 6:1 Reduction System (CH270). | Gear Reduction System |

Every 300 Hours[2]

| | |
|---|---|
| ● Check and adjust valve clearance when engine is cold. | Reassembly |

Every 500 Hours or Annually[1]

| | |
|---|---|
| ● Replace spark plug and set gap. | Electrical System |

[1] Perform these procedures more frequently under severe, dusty, dirty conditions.
[2] Have a Kohler authorized dealer perform this service.

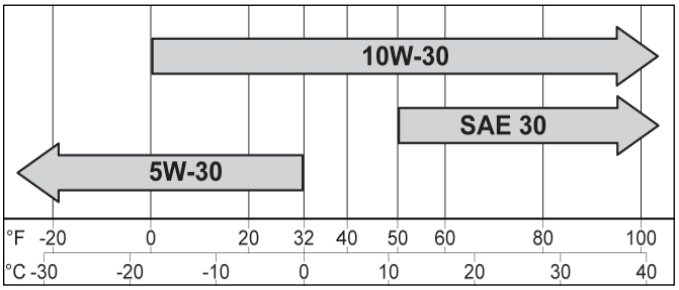
## REPAIRS/SERVICE PARTS

Kohler genuine service parts can be purchased from Kohler authorized dealers. To find a local Kohler authorized dealer visit KohlerEngines.com or call 1-800-544-2444 (U.S. and Canada).

# Maintenance

### OIL RECOMMENDATIONS

We recommend use of Kohler oils for best performance. Other high-quality detergent oils (including synthetic) of API (American Petroleum Institute) service class SJ or higher are acceptable. Select viscosity based on air temperature at time of operation as shown in table below.




### FUEL RECOMMENDATIONS

**⚠ WARNING**

Explosive Fuel can cause fires and severe burns.

Do not fill fuel tank while engine is hot or running.

Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Never use gasoline as a cleaning agent.

NOTE: E15, E20 and E85 are NOT approved and should NOT be used; effects of old, stale or contaminated fuel are not warrantable.

Fuel must meet these requirements:

- Clean, fresh, unleaded gasoline.
- Octane rating of 87 (R+M)/2 or higher.
- Research Octane Number (RON) 90 octane minimum.
- Gasoline up to 10% ethyl alcohol, 90% unleaded is acceptable.
- Methyl Tertiary Butyl Ether (MTBE) and unleaded gasoline blend (max 15% MTBE by volume) are approved.
- Do not add oil to gasoline.
- Do not overfill fuel tank.
- Do not use gasoline older than 30 days.

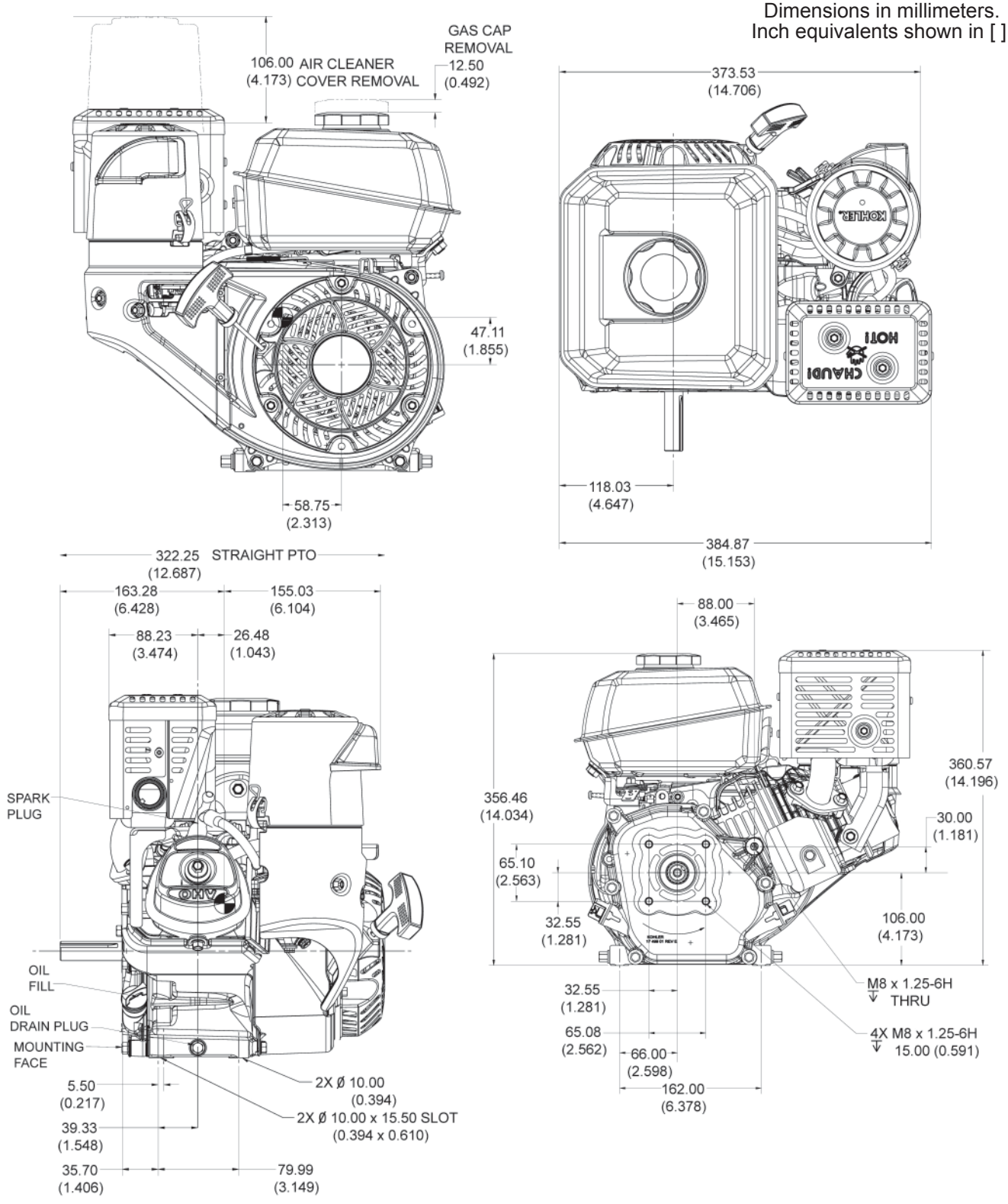
### STORAGE

If engine will be out of service for 2 months or more follow procedure below.

1. Add Kohler PRO Series fuel treatment or equivalent to fuel tank. Run engine 2-3 minutes to get stabilized fuel into fuel system (failures due to untreated fuel are not warrantable).
2. Change oil while engine is still warm from operation. Remove spark plug(s) and pour about 1 oz. of engine oil into cylinder(s). Replace spark plug(s) and crank engine slowly to distribute oil.
3. Disconnect negative (-) battery cable.
4. Store engine in a clean, dry place.

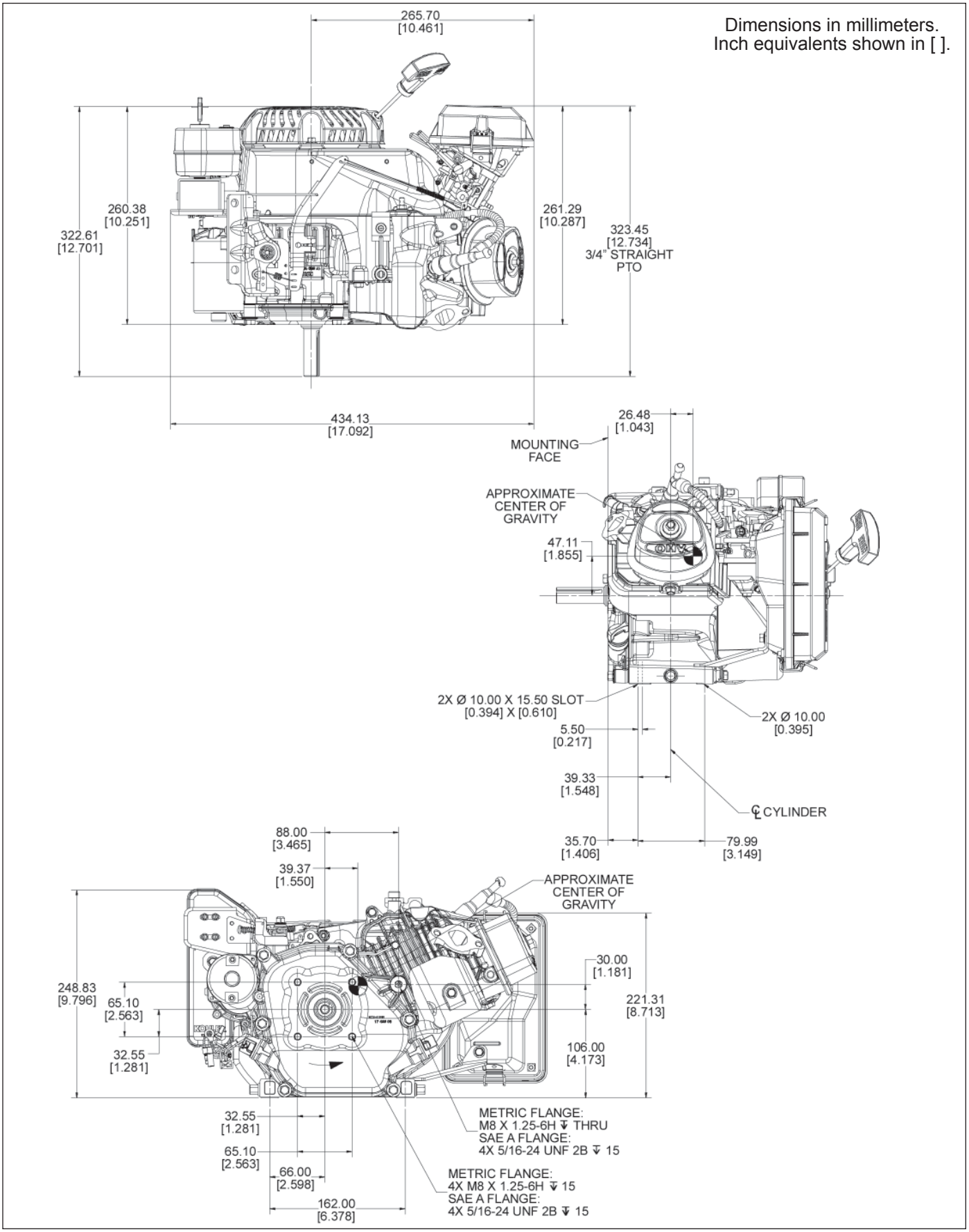
**CH260/CH270 Engine Dimensions**

Dimensions in millimeters.
Inch equivalents shown in [ ].

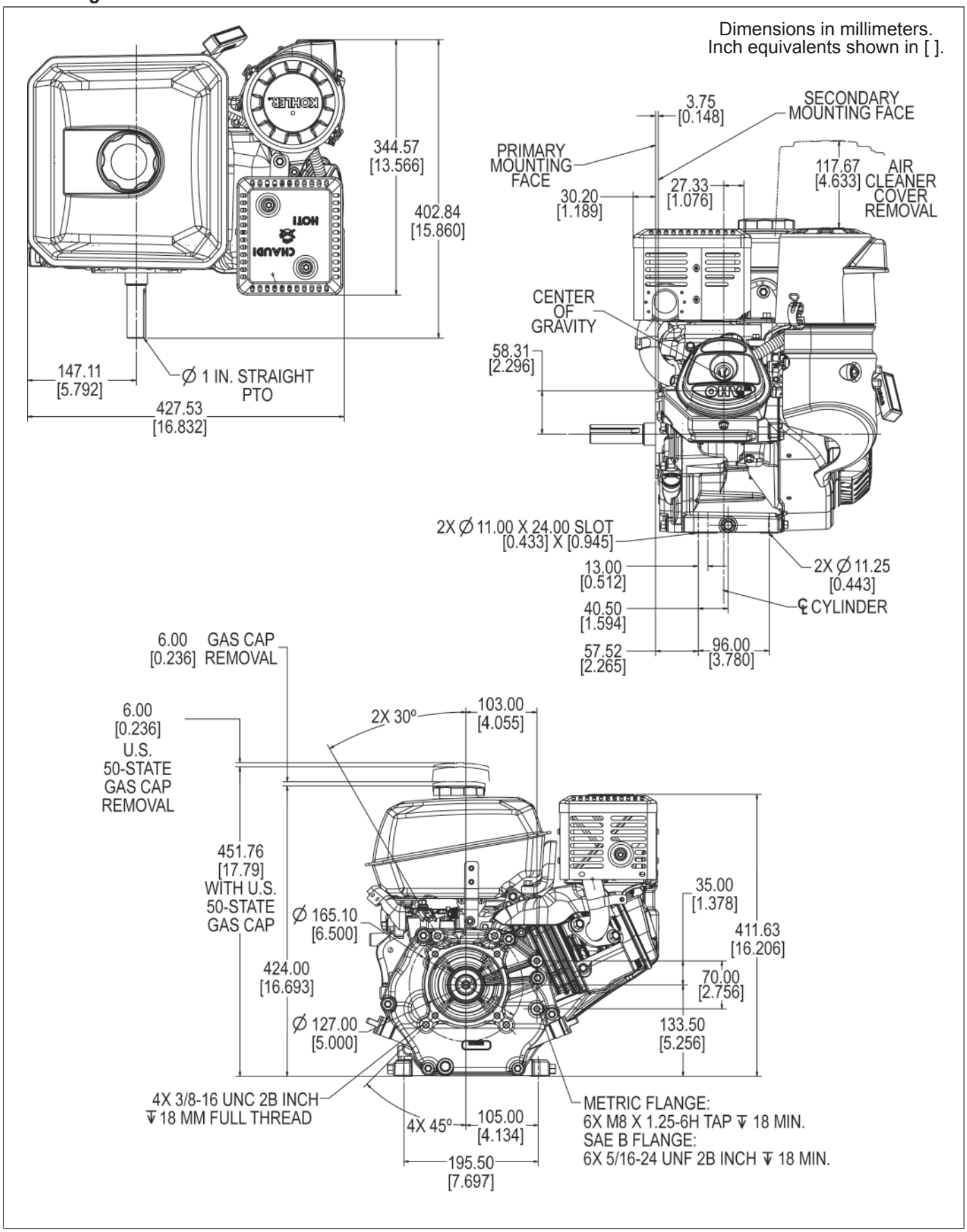


# Specifications

### CH260/CH270 Engine Dimensions

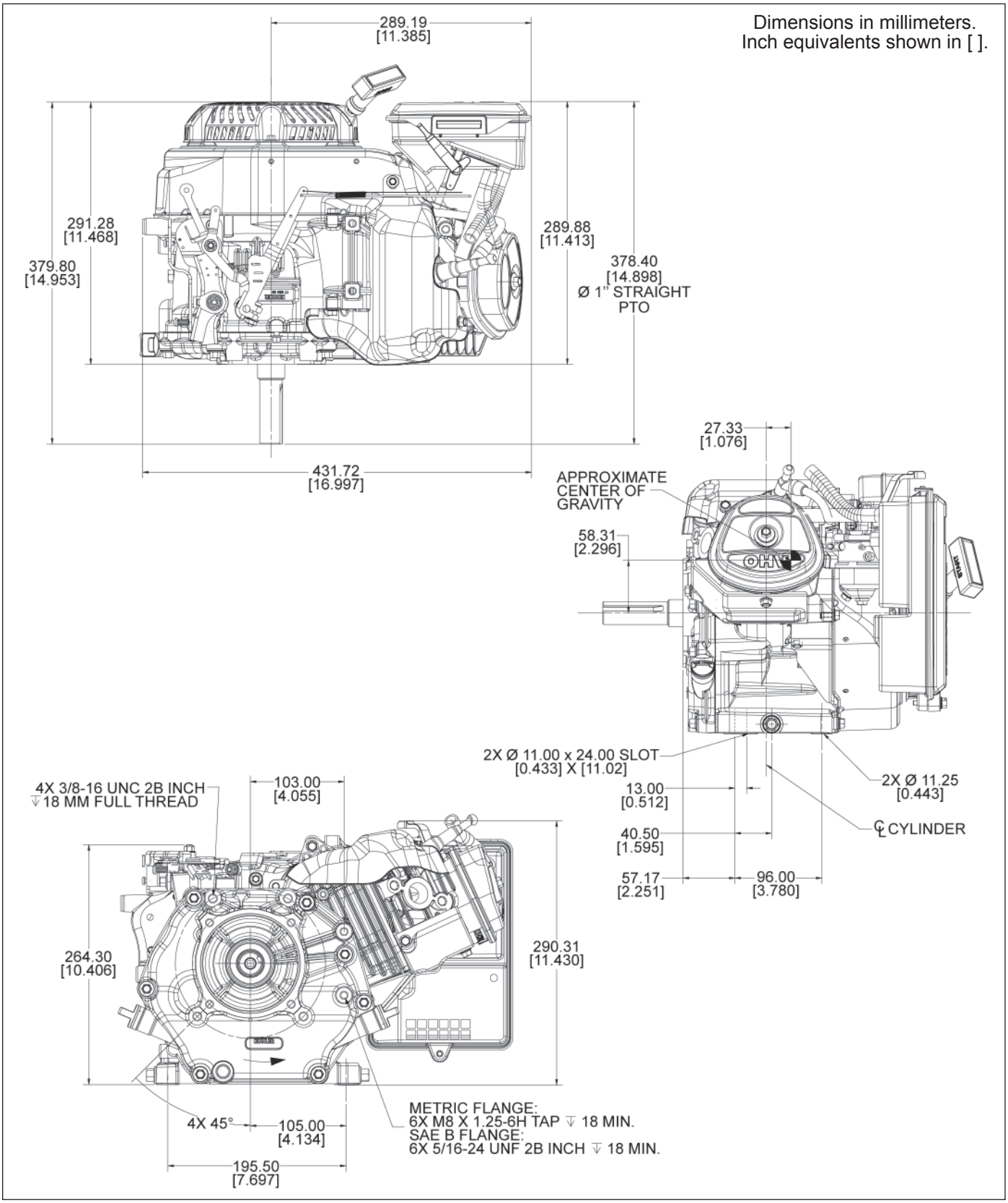


**CH395 Engine Dimensions**

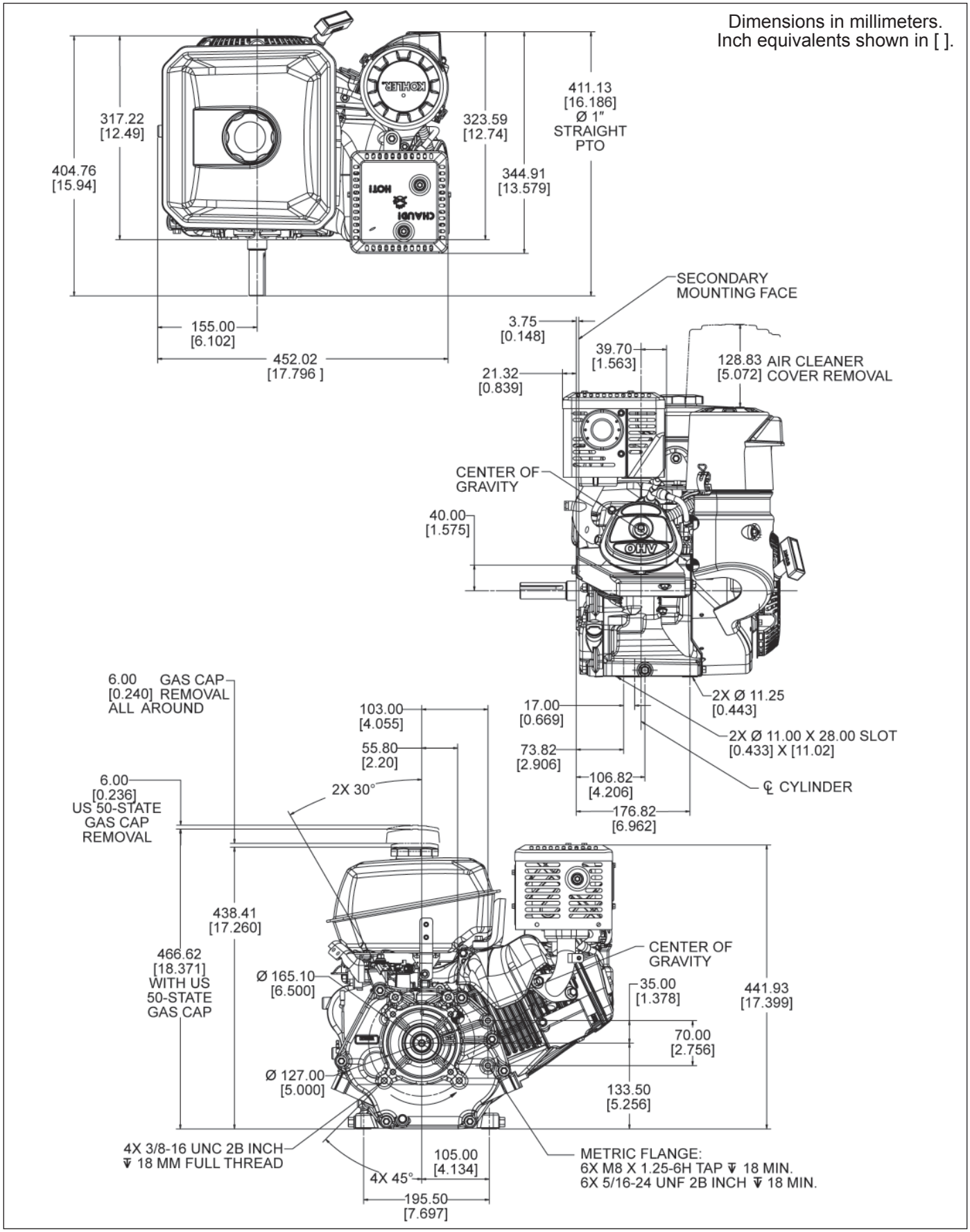


# Specifications

### CH395 Engine Dimensions

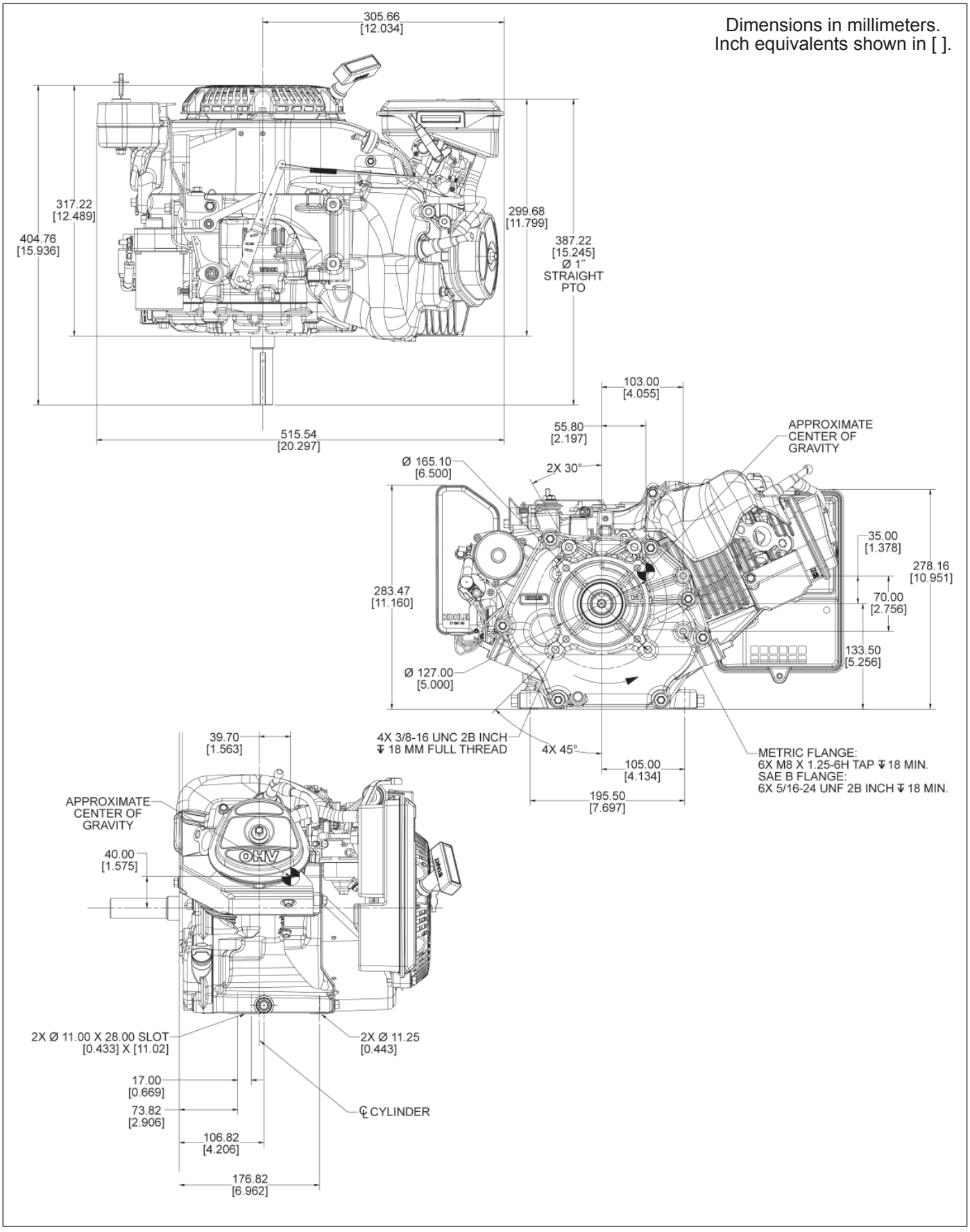


**CH440 Engine Dimensions**



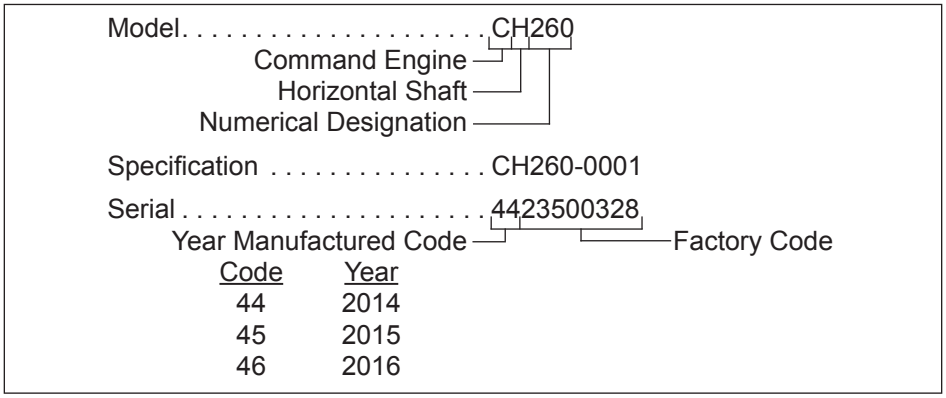
# Specifications

### CH440 Engine Dimensions



## ENGINE IDENTIFICATION NUMBERS

Kohler engine identification numbers (model, specification and serial) should be referenced for efficient repair, ordering correct parts, and engine replacement.




| GENERAL SPECIFICATIONS[3,6] | CH260/CH270 | CH395 | CH440 |
|---|---|---|---|
| Bore | 70 mm (2.8 in.) | 78 mm (3.1 in.) | 89 mm (3.5 in.) |
| Stroke | 54 mm (2.1 in.) | 58 mm (2.3 in.) | 69 mm (2.7 in.) |
| Displacement | 208 cc (12.7 cu. in.) | 277 cc (16.9 cu. in.) | 429 cc (26.2 cu. in.) |
| Oil Capacity (refill) | 0.6 L (0.63 U.S. qt.) | 1.1 L (1.16 U.S. qt.) | 1.3 L (1.37 U.S. qt.) |
| Maximum Angle of Operation (@ full oil level)[4] | 25° | | |

| TORQUE SPECIFICATIONS[3,5] | CH260/CH270 | CH395 | CH440 |
|---|---|---|---|
| **Air Cleaner** | | | |
| Quad-Clean™ Air Cleaner Base Mounting Screw | 8.0 N·m (71 in. lb.) | | |
| Low-Profile Air Cleaner Base Mounting Screw | 6.7 N·m (59 in. lb.) | | |
| **Blower Housing and Sheet Metal** | | | |
| M6 Screw | 10 N·m (89 in. lb.) | | |
| M6 Nut | 8.0 N·m (71 in. lb.) | | |
| **Carburetor** | | | |
| Stud | 10 N·m (89 in. lb.) | | |
| Primary Nut | 8 N·m (71 in. lb.) | | |
| Intake Cover Nut | 4 N·m (35 in. lb.) | | |
| Intake Cover Screw | 1.3 N·m (12 in. lb.) | | |
| **Connecting Rod** | | | |
| Cap Fastener (torque in increments) | 12 N·m (106 in. lb.) | 20 N·m (177 in. lb.) | |

[3] Values are in Metric units. Values in parentheses are English equivalents.

[4] Exceeding maximum angle of operation may cause engine damage from insufficient lubrication.

[5] Lubricate threads with engine oil prior to assembly.

[6] Any and all horsepower (hp) references by Kohler are Certified Power Ratings and per SAE J1940 & J1995 hp standards. Details on Certified Power Ratings can be found at KohlerEngines.com.

# Specifications

| TORQUE SPECIFICATIONS[3,5] | CH260/CH270 | CH395 | CH440 |
|---|---|---|---|
| **Crankcase** | | | |
| Oil Drain Plug | 18 N·m (13 ft. lb.) | | |
| Closure Plate Screw | 24 N·m (212 in. lb.) | | |
| **Cylinder Head** | | | |
| Fastener (torque in 2 increments) | First to 12 N·m (106 in. lb.) Finally to 24 N·m (212 in. lb.) | First to 18 N·m (159 in. lb.) Finally to 36 N·m (319 in. lb.) | |
| **Electric Starter** | | | |
| Mounting Screw | 24 N·m (212 in. lb.) | | |
| **Electric Starter Drive CH440 Type II Starter** | | | |
| Assembly Screw 5 mm | --- | --- | 5.8 N·m (51 in. lb.) |
| Brush Lead Connector Wire Screw 4 mm | --- | --- | 1.7 N·m (15 in. lb.) |
| **Electric Starter Relay (Solenoid) CH395, CH440** | | | |
| Mounting Screw | --- | 3.2 N·m (28 in. lb.) | |
| Nut | --- | 4.5 N·m (40 in. lb.) | |
| **Flywheel** | | | |
| Retaining Nut | 74 N·m (655 in. lb.) | 113 N·m (1000 in. lb.) | |
| **Fuel Tank** | | | |
| Mounting Nut | 24 N·m (212 in. lb.) | | |
| Mounting Screw | 24 N·m (212 in. lb.) | | |
| Inlet Fitting | 1.5 N·m (13 in. lb.) | | |
| **Gear Reduction** | | | |
| M6 Screws | 7.4 N·m (66 in. lb.) | | |
| M8 Screws | 24.4 N·m (216 in. lb.) | | |
| **Governor (Electronic)** | | | |
| Electronic Governor Control to Crankcase | 24 N·m (212 in. lb.) | | |
| **Governor (Mechanical)** | | | |
| Lever Nut | 12 N·m (106 in. lb.) | | |
| Throttle Control Lever Nut | 9 N·m (80 in. lb.) | | |

[3] Values are in Metric units. Values in parentheses are English equivalents.

[5] Lubricate threads with engine oil prior to assembly.

| TORQUE SPECIFICATIONS[3,5] | CH260/CH270 | CH395 | CH440 |
|---|---|---|---|
| **Ignition** | | | |
| Spark Plug | 27 N·m (20 ft. lb.) | | |
| Module Fastener | 10 N·m (89 in. lb.) | | |
| Oil Sentry™ Float Switch Screw | 8 N·m (71 in. lb.) | | |
| Oil Sentry™ Module Screw | 3.5 N·m (31 in. lb.) | | |
| Oil Sentry™ Wire Lead Nut | 10 N·m (89 in. lb.) | | |
| **Muffler** | | | |
| Exhaust Screw<br>M8<br>M10 | 24 N·m (212 in. lb.)<br>--- | ---<br>35 N·m (310 in. lb.) | |
| Muffler Shield Screw<br>M6 | 8 N·m (71 in. lb.) | | |
| M4 | 2 N·m (18 in. lb.) | 3.5 N·m (31 in. lb.) | |
| Spark Arrestor Screw M5 | 3.5 N·m (31 in. lb.) | | |
| **Retractable Starter** | | | |
| Cover Screw | 5.4 N·m (48 in. lb.) | | |
| Center Screw | 10 N·m (89 in. lb.) | | |
| **Rocker Arm** | | | |
| Stud | 13.6 N·m (120 in. lb.) | | |
| Pivot Jam Nut | 10 N·m (89 in. lb.) | | |
| **Valve Cover** | | | |
| Fastener | 10 N·m (89 in. lb.) | | |

| CLEARANCE SPECIFICATIONS[3] | CH260/CH270 | CH395 | CH440 |
|---|---|---|---|
| **Camshaft** | | | |
| Running Clearance | 0.007/0.043 mm (0.0003/0.0017 in.) | 0.016/0.052 mm (0.0006/0.0020 in.) | |
| Bore I.D.<br>New | 14.000/14.018 mm (0.5512/0.5519 in.) | 16.000/16.018 mm (0.6299/0.6306 in.) | |
| Max. Wear Limit | 14.018 mm (0.5519 in.) | 16.068 mm (0.6326 in.) | |
| Camshaft Bearing Surface O.D.<br>New | 13.975 mm (0.5502 in.) | 15.975 mm (0.6289 in.) | |
| Max. Wear Limit | 13.90 mm (0.547 in.) | 15.90 mm (0.626 in.) | |
| Cam Lobe Profile (minimum dimension, measured from base circle to top of lobe)<br>Intake - New | 27.787 mm (1.094 in.) | 32.408 mm (1.276 in.) | 32.286 mm (1.271 in.) |
| Max. Wear Limit | 27.533 mm (1.084 in.) | 32.154 mm (1.266 in.) | 32.032 mm (1.261 in.) |
| Exhaust - New | 27.861 mm (1.097 in.) | 32.12 mm (1.265 in.) | 32.506 mm (1.280 in.) |
| Max. Wear Limit | 27.607 mm (1.087 in.) | 31.866 mm (1.255 in.) | 32.252 mm (1.270 in.) |

[3] Values are in Metric units. Values in parentheses are English equivalents.

[5] Lubricate threads with engine oil prior to assembly.

# Specifications

| CLEARANCE SPECIFICATIONS[3] | CH260/CH270 | CH395 | CH440 |
|---|---|---|---|
| **Connecting Rod** | | | |
| Crankpin End I.D. @ 21°C (70°F) New | 30.020/30.030 mm (1.1819/1.1823 in.) | 33.020/33.030 mm (1.3000/1.3004 in.) | 37.020/37.030 mm (1.4575/1.4579 in.) |
| Max. Wear Limit | 30.106 mm (1.185 in.) | 33.07 mm (1.302 in.) | 37.08 mm (1.460 in.) |
| Connecting Rod-to-Crankpin Side Clearance | | | |
| New | 0.58/0.60 mm (0.023/0.024 in.) | 0.73 mm (0.029 in.) | 0.56 mm (0.022 in.) |
| Max. Wear Limit | 1.10 mm (0.043 in.) | 1.36 mm (0.054 in.) | 1.06 mm (0.042 in.) |
| Connecting Rod-to-Piston Pin Running Clearance | 0.008/0.025 mm (0.0003/0.0010 in.) | 0.006/0.028 mm (0.0002/0.0011 in.) | 0.008/0.025 mm (0.0003/0.0010 in.) |
| Piston Pin End I.D. @ 21°C (70°F) New | 18.006/18.017 mm (0.7089/0.7093 in.) | | 20.006/20.017 mm (0.7876/0.7881 in.) |
| Max. Wear Limit | 18.08 mm (0.712 in.) | | 20.03 mm (0.789 in.) |
| **Crankcase** | | | |
| Governor Cross Shaft Bore I.D. New | 6.000/6.024 mm (0.2362/0.2372 in.) | 8.000/8.024 mm (0.3150/0.3159 in.) | |
| Max. Wear Limit | 6.037 mm (0.2377 in.) | 8.075 mm (0.3179 in.) | |
| **Crankshaft** | | | |
| End Play (free) | 0.0508/0.254 mm (0.002/0.010 in.) | | |
| Ball Bearing Internal Clearance | 0.003/0.025 mm (0.0001/0.0010 in.) | 0.005/0.020 mm (0.0002/0.0008 in.) | 0.006/0.020 mm (0.0002/0.0008 in.) |
| Crankshaft O.D. (new) PTO end | 24.975/24.989 mm (0.9833/0.9838 in.) | 29.975/29.989 mm (1.1801/1.1807 in.) | 34.975/34.989 mm (1.3770/1.3775 in.) |
| Flywheel end | | 30.014/30.027 mm (1.1817/1.1822 in.) | 35.009/35.027 mm (1.3783/1.3790 in.) |
| Connecting Rod Journal O.D. New | 29.975/29.985 mm (1.1801/1.1805 in.) | 32.975/32.985 mm (1.2982/1.2986 in.) | 36.975/36.985 mm (1.4557/1.4561 in.) |
| Max. Wear Limit | 29.924 mm (1.1781 in.) | 32.92 mm (1.2961 in.) | 36.92 mm (1.4535 in.) |
| Max. Taper<br>Max. Out-of-Round | 2.5 microns (0.0001 in.)<br>12.7 microns (0.0005 in.) | | |
| Width | 25.02/25.08 mm (0.9850/0.9874 in.) | 30.30/30.36 mm (1.1930/1.1953 in.) | 28.30/28.36 mm (1.1142/1.1165 in.) |
| Runout (either end) | 0.025 mm (0.001 in.) | | |
| Main Bearing I.D. (Crankcase/Closure Plate) New (installed) | 24.992/25.000 mm (0.9839/0.9842 in.) | 29.990/30.000 mm 1.1807/1.1811 in.) | 34.988/35.000 mm (1.3775/1.3779 in.) |
| **Cylinder Bore** | | | |
| Bore I.D. New | 70.020/70.035 mm (2.7570/2.7573 in.) | 78.000/78.015 mm (3.0709/3.0714 in.) | 89.000/89.015 mm (3.5039/3.5045 in.) |
| Max. Wear Limit | 70.200 mm (2.764 in.) | 78.185 mm (3.0781 in.) | 89.185 mm (3.5112 in.) |
| Max. Out-of-Round<br>Max. Taper | 12.7 microns (0.0005 in.)<br>12.7 microns (0.0005 in.) | | |

[3] Values are in Metric units. Values in parentheses are English equivalents.

| CLEARANCE SPECIFICATIONS[3] | CH260/CH270 | CH395 | CH440 |
|---|---|---|---|
| **Cylinder Head** | | | |
| Max. Out-of-Flatness | 0.08 mm (0.003 in.) | 0.1 mm (0.0039 in.) | |
| **Governor (Mechanical)** | | | |
| Governor Cross Shaft -to-Crankcase Running Clearance | 0.020/0.069 mm (0.0008/0.0027 in.) | | |
| Governor Cross Shaft O.D. New | 5.955/5.980 mm (0.2344/0.2354 in.) | 7.955/7.980 mm (0.3132/0.3142 in.) | |
| Max. Wear Limit | 5.942 mm (0.2339 in.) | 7.900 mm (0.3110 in.) | |
| Governor Gear Shaft -to-Governor Gear Running Clearance | 0.022/0.134 mm (0.0009/0.0053 in.) | | |
| Governor Gear Shaft O.D. New<br>Max. Wear Limit | 6.016/6.028 mm (0.2368/0.2373 in.)<br>6.003 mm (0.2363 in.) | | |
| **Ignition** | | | |
| Spark Plug Gap | 0.76 mm (0.030 in.) | | |
| Module Air Gap | 0.254 mm (0.010 in.) | | |
| **Piston, Piston Rings, and Piston Pin** | | | |
| Piston-to-Piston Pin Running Clearance | 0.009/0.016 mm (0.0003/0.0006 in.) | 0.002/0.016 mm (0.0001/0.0006 in.) | |
| Piston Pin Bore I.D. New | 18.000/18.008 mm (0.7087/0.7090 in.) | | 20.000/20.008 mm (0.7874/0.7877 in.) |
| Max. Wear Limit | 18.05 mm (0.7106 in.) | | 20.05 mm (0.7894 in.) |
| Piston Pin O.D. New | 17.992/17.998 mm (0.7083/0.7084 in.) | | 19.992/19.998 mm (0.7871/0.7873 in.) |
| Max. Wear Limit | 17.95 mm (0.7067 in.) | | 19.95 mm (0.7854 in.) |
| Top and Center Compression Ring Side Clearance New Bore | 0.04 mm (0.002 in.) | 0.07 mm (0.003 in.) | 0.045 mm (0.0018 in.) |
| Used Bore (Max.) | 0.15 mm (0.006 in.) | 0.11 mm (0.004 in.) | 0.10 mm (0.004 in.) |
| Top Compression Ring End Gap New Bore | 0.325/0.400 mm (0.013/0.016 in.) | 0.250/0.400 mm (0.010/0.016 in.) | |
| Used Bore (Max.) | 1.00 mm (0.039 in.) | | |
| Center Compression Ring End Gap New Bore | 0.325/0.400 mm (0.013/0.016 in.) | 0.650/0.800 mm (0.026/0.032 in.) | 0.640/0.800 mm (0.025/0.032 in.) |
| Used Bore (Max.) | 1.00 mm (0.039 in.) | 1.50 mm (0.059 in.) | |

[3] Values are in Metric units. Values in parentheses are English equivalents.

# Specifications

Piston, Piston Rings, and Piston Pin (continued)

| CLEARANCE SPECIFICATIONS[3] | CH260/CH270 | CH395 | CH440 |
|---|---|---|---|
| Oil Control Ring-to-Groove Side Clearance | 0.05/0.19 mm (0.0019/0.0075 in.) | | 0.09/0.15 mm (0.0035/0.0059 in.) |
| Piston Thrust Face O.D. New | 69.975/69.995 mm (2.755/2.756 in.)[7] | 77.955/77.975 mm (3.069/3.070 in.)[8] | 88.955/88.975 mm (3.502/3.503 in.)[9] |
| Max. Wear Limit | 69.82 mm (2.749 in.) | 77.82 mm (3.064 in.) | 88.82 mm (3.497 in.) |
| Piston Thrust Face-to-Cylinder Bore Running Clearance | 0.057/0.075 mm (0.002/0.003 in.)[7] | 0.033/0.067 mm (0.001/0.003 in.)[8] | 0.025/0.060 mm (0.001/0.002 in.)[9] |

Valves and Valve Tappets

| | | | |
|---|---|---|---|
| Intake and Exhaust Valve Lash | 0.0762/0.127 mm (0.003/0.005 in.) | | |
| Intake Valve Stem-to-Valve Guide Running Clearance | 0.038/0.065 mm (0.0015/0.0026 in.) | 0.025/0.055 mm (0.0010/0.0022 in.) | |
| Exhaust Valve Stem-to-Valve Guide Running Clearance | 0.085/0.112 mm (0.0033/0.0044 in.) | 0.040/0.07 mm (0.0016/0.0028 in.) | |
| Intake Valve Stem O.D. New | 5.50 mm (0.217 in.) | 6.57 mm (0.259 in.) | |
| Max. Wear Limit | 5.34 mm (0.210 in.) | 6.40 mm (0.252 in.) | |
| Exhaust Valve Stem O.D. New | 5.438 mm (0.214 in.) | 6.55 mm (0.258 in.) | |
| Max. Wear Limit | 5.28 mm (0.208 in.) | 6.41 mm (0.252 in.) | |
| Intake Valve Stem to Guide New | 0.024/0.039 mm (0.0009/0.0015 in.) | 0.025/0.055 mm (0.0010/0.0022 in.) | |
| Max. Wear Limit | 0.10 mm (0.0039 in.) | 0.13 mm (0.0051 in.) | 0.14 mm (0.0055 in.) |
| Exhaust Valve Stem to Guide New | 0.098/0.112 mm (0.0038/0.0044 in.) | 0.040/0.070 mm (0.0016/0.0028 in.) | |
| Max. Wear Limit | 0.12 mm (0.0047 in.) | 0.10 mm (0.0039 in.) | 0.11 mm (0.0043 in.) |
| Valve Guide Reamer Size Standard Intake | 5.524 mm (0.2175 in.) | 6.608 mm (0.2602 in.) | |
| Standard Exhaust | 5.536 mm (0.2179 in.) | 6.608 mm (0.2602 in.) | |
| Valve Seat Width | 0.80 mm (0.0315 in.) | 1.10 mm (0.0433 in.) | 1.20 mm (0.0472 in.) |
| Nominal Valve Face Angle | 45° | | |

[3] Values are in Metric units. Values in parentheses are English equivalents.

[7] Measure 21.8-22.2 mm (0.8583-0.8740 in.) above bottom of piston skirt at right angles to piston pin.

[8] Measure 17.8-18.2 mm (0.7008-0.7165 in.) above bottom of piston skirt at right angles to piston pin.

[9] Measure 29.8-30.2 mm (1.1732-1.1890 in.) above bottom of piston skirt at right angles to piston pin.

## GENERAL TORQUE VALUES

| English Fastener Torque Recommendations for Standard Applications | | | | |
|---|---|---|---|---|
| | Bolts, Screws, Nuts and Fasteners Assembled Into Cast Iron or Steel | | | Grade 2 or 5 Fasteners Into Aluminum |
| Size | Grade 2 | Grade 5 | Grade 8 | |
| **Tightening Torque: N·m (in. lb.) ± 20%** | | | | |
| 8-32 | 2.3 (20) | 2.8 (25) | — | 2.3 (20) |
| 10-24 | 3.6 (32) | 4.5 (40) | — | 3.6 (32) |
| 10-32 | 3.6 (32) | 4.5 (40) | — | — |
| 1/4-20 | 7.9 (70) | 13.0 (115) | 18.7 (165) | 7.9 (70) |
| 1/4-28 | 9.6 (85) | 15.8 (140) | 22.6 (200) | — |
| 5/16-18 | 17.0 (150) | 28.3 (250) | 39.6 (350) | 17.0 (150) |
| 5/16-24 | 18.7 (165) | 30.5 (270) | — | — |
| 3/8-16 | 29.4 (260) | — | — | — |
| 3/8-24 | 33.9 (300) | — | — | — |
| **Tightening Torque: N·m (ft. lb.) ± 20%** | | | | |
| 5/16-24 | — | — | 40.7 (30) | — |
| 3/8-16 | — | 47.5 (35) | 67.8 (50) | — |
| 3/8-24 | — | 54.2 (40) | 81.4 (60) | — |
| 7/16-14 | 47.5 (35) | 74.6 (55) | 108.5 (80) | — |
| 7/16-20 | 61.0 (45) | 101.7 (75) | 142.5 (105) | — |
| 1/2-13 | 67.8 (50) | 108.5 (80) | 155.9 (115) | — |
| 1/2-20 | 94.9 (70) | 142.4 (105) | 223.7 (165) | — |
| 9/16-12 | 101.7 (75) | 169.5 (125) | 237.3 (175) | — |
| 9/16-18 | 135.6 (100) | 223.7 (165) | 311.9 (230) | — |
| 5/8-11 | 149.5 (110) | 244.1 (180) | 352.6 (260) | — |
| 5/8-18 | 189.8 (140) | 311.9 (230) | 447.5 (330) | — |
| 3/4-10 | 199.3 (147) | 332.2 (245) | 474.6 (350) | — |
| 3/4-16 | 271.2 (200) | 440.7 (325) | 637.3 (470) | — |

| Metric Fastener Torque Recommendations for Standard Applications | | | | | | |
|---|---|---|---|---|---|---|
| | Property Class | | | | | Noncritical Fasteners Into Aluminum |
| Size | 4.8 | 5.8 | 8.8 | 10.9 | 12.9 | |
| **Tightening Torque: N·m (in. lb.) ± 10%** | | | | | | |
| M4 | 1.2 (11) | 1.7 (15) | 2.9 (26) | 4.1 (36) | 5.0 (44) | 2.0 (18) |
| M5 | 2.5 (22) | 3.2 (28) | 5.8 (51) | 8.1 (72) | 9.7 (86) | 4.0 (35) |
| M6 | 4.3 (38) | 5.7 (50) | 9.9 (88) | 14.0 (124) | 16.5 (146) | 6.8 (60) |
| M8 | 10.5 (93) | 13.6 (120) | 24.4 (216) | 33.9 (300) | 40.7 (360) | 17.0 (150) |
| **Tightening Torque: N·m (ft. lb.) ± 10%** | | | | | | |
| M10 | 21.7 (16) | 27.1 (20) | 47.5 (35) | 66.4 (49) | 81.4 (60) | 33.9 (25) |
| M12 | 36.6 (27) | 47.5 (35) | 82.7 (61) | 116.6 (86) | 139.7 (103) | 61.0 (45) |
| M14 | 58.3 (43) | 76.4 (56) | 131.5 (97) | 184.4 (136) | 219.7 (162) | 94.9 (70) |

| Torque Conversions | |
|---|---|
| N·m = in. lb. x 0.113 | in. lb. = N·m x 8.85 |
| N·m = ft. lb. x 1.356 | ft. lb. = N·m x 0.737 |

# Tools and Aids

Certain quality tools are designed to help you perform specific disassembly, repair, and reassembly procedures. By using these tools, you can properly service engines easier, faster, and safer! In addition, you'll increase your service capabilities and customer satisfaction by decreasing engine downtime.

Here is a list of tools and their source.

**SEPARATE TOOL SUPPLIERS**

Kohler Tools
Contact your local Kohler source of supply.

SE Tools
415 Howard St.
Lapeer, MI 48446
Phone 810-664-2981
Toll Free 800-664-2981
Fax 810-664-8181

Design Technology Inc.
768 Burr Oak Drive
Westmont, IL 60559
Phone 630-920-1300
Fax 630-920-0011

**TOOLS**

| Description | Source/Part No. |
|---|---|
| **Alcohol Content Tester**<br>For testing alcohol content (%) in reformulated/oxygenated fuels. | Kohler 25 455 11-S |
| **Camshaft Endplay Plate**<br>For checking camshaft endplay. | SE Tools KLR-82405 |
| **Camshaft Seal Protector (Aegis)**<br>For protecting seal during camshaft installation. | SE Tools KLR-82417 |
| **Cylinder Leakdown Tester**<br>For checking combustion retention and if cylinder, piston, rings, or valves are worn.<br>Individual component available:<br>Adapter 12 mm x 14 mm (Required for leakdown test on XT-6 engines) | Kohler 25 761 05-S<br><br>Design Technology Inc.<br>DTI-731-03 |
| **Dealer Tool Kit (Domestic)**<br>Complete kit of Kohler required tools.<br>Components of 25 761 39-S<br>Ignition System Tester<br>Cylinder Leakdown Tester<br>Oil Pressure Test Kit<br>Rectifier-Regulator Tester (120 V AC/60Hz) | Kohler 25 761 39-S<br><br><br>Kohler 25 455 01-S<br>Kohler 25 761 05-S<br>Kohler 25 761 06-S<br>Kohler 25 761 20-S |
| **Dealer Tool Kit (International)**<br>Complete kit of Kohler required tools.<br>Components of 25 761 42-S<br>Ignition System Tester<br>Cylinder Leakdown Tester<br>Oil Pressure Test Kit<br>Rectifier-Regulator Tester (240 V AC/50Hz) | Kohler 25 761 42-S<br><br><br>Kohler 25 455 01-S<br>Kohler 25 761 05-S<br>Kohler 25 761 06-S<br>Kohler 25 761 41-S |
| **Digital Vacuum/Pressure Tester**<br>For checking crankcase vacuum.<br>Individual component available:<br>Rubber Adapter Plug | Design Technology Inc.<br>DTI-721-01<br>Design Technology Inc.<br>DTI-721-10 |
| **Electronic Fuel Injection (EFI) Diagnostic Software**<br>For Laptop or Desktop PC. | Kohler 25 761 23-S |
| **EFI Service Kit**<br>For troubleshooting and setting up an EFI engine.<br>Components of 24 761 01-S<br>Fuel Pressure Tester<br>Noid Light<br>90° Adapter<br>Code Plug, Red Wire<br>Code Plug, Blue Wire<br>Shrader Valve Adapter Hose<br>Wire Probe Set (2 pieces regular wire with clip; 1 piece fused wire)<br>Hose Removal Tool, Dual Size/End (also sold as individual Kohler tool) | Kohler 24 761 01-S<br><br>Design Technology Inc.<br>DTI-019<br>DTI-021<br>DTI-023<br>DTI-027<br>DTI-029<br>DTI-037<br>DTI-031<br>DTI-033 |
| **Flywheel Puller**<br>For properly removing flywheel from engine. | SE Tools KLR-82408 |

**TOOLS**

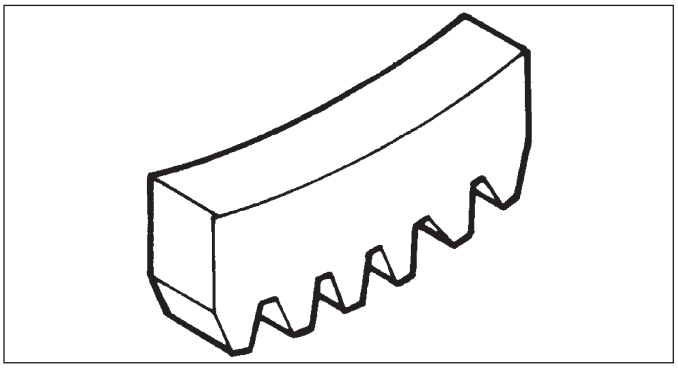
| Description | Source/Part No. |
|---|---|
| **Hose Removal Tool, Dual Size/End (also available in EFI Service Kit)**<br>Used to properly remove fuel hose from engine components. | Kohler 25 455 20-S |
| **Hydraulic Valve Lifter Tool**<br>For removing and installing hydraulic lifters. | Kohler 25 761 38-S |
| **Ignition System Tester**<br>For testing output on all systems, including CD. | Kohler 25 455 01-S |
| **Inductive Tachometer (Digital)**<br>For checking operating speed (RPM) of an engine. | Design Technology Inc.<br>DTI-110 |
| **Offset Wrench (K and M Series)**<br>For removing and reinstalling cylinder barrel retaining nuts. | Kohler 52 455 04-S |
| **Oil Pressure Test Kit**<br>For testing/verifying oil pressure on pressure lubricated engines. | Kohler 25 761 06-S |
| **Rectifier-Regulator Tester (120 volt current)**<br>**Rectifier-Regulator Tester (240 volt current)**<br>For testing rectifier-regulators.<br>Components of 25 761 20-S and 25 761 41-S<br>CS-PRO Regulator Test Harness<br>Special Regulator Test Harness with Diode | Kohler 25 761 20-S<br>Kohler 25 761 41-S<br><br>Design Technology Inc.<br>DTI-031R<br>DTI-033R |
| **Spark Advance Module (SAM) Tester**<br>For testing SAM (ASAM and DSAM) on engines with SMART-SPARK™. | Kohler 25 761 40-S |
| **Starter Servicing Kit (All Starters)**<br>For removing and reinstalling drive retaining rings and brushes.<br>Individual component available:<br>Starter Brush Holding Tool (Solenoid Shift) | SE Tools KLR-82411<br><br><br>SE Tools KLR-82416 |
| **Triad/OHC Timing Tool Set**<br>For holding cam gears and crankshaft in timed position while installing timing belt. | Kohler 28 761 01-S |
| **Valve Guide Reamer (K and M Series)**<br>For properly sizing valve guides after installation. | Design Technology Inc.<br>DTI-K828 |
| **Valve Guide Reamer O.S. (Command Series)**<br>For reaming worn valve guides to accept replacement oversize valves. Can be used in low-speed drill press or with handle below for hand reaming. | Kohler 25 455 12-S |
| **Reamer Handle**<br>For hand reaming using Kohler 25 455 12-S reamer. | Design Technology Inc.<br>DTI-K830 |

**AIDS**

| Description | Source/Part No. |
|---|---|
| **Camshaft Lubricant (Valspar ZZ613)** | Kohler 25 357 14-S |
| **Dielectric Grease (GE/Novaguard G661)** | Kohler 25 357 11-S |
| **Dielectric Grease** | Loctite® 51360 |
| **Kohler Electric Starter Drive Lubricant (Inertia Drive)** | Kohler 52 357 01-S |
| **Kohler Electric Starter Drive Lubricant (Solenoid Shift)** | Kohler 52 357 02-S |
| **RTV Silicone Sealant**<br>Loctite® 5900® Heavy Body in 4 oz. aerosol dispenser.<br>Only oxime-based, oil resistant RTV sealants, such as those listed, are approved for use. Permatex® the Right Stuff® 1 Minute Gasket™ or Loctite® Nos. 5900® or 5910® are recommended for best sealing characteristics. | Kohler 25 597 07-S<br>Loctite® 5910®<br>Loctite® Ultra Black 598™<br>Loctite® Ultra Blue 587™<br>Loctite® Ultra Copper 5920™<br>Permatex® the Right Stuff® 1 Minute Gasket™ |
| **Spline Drive Lubricant** | Kohler 25 357 12-S |

# Tools and Aids

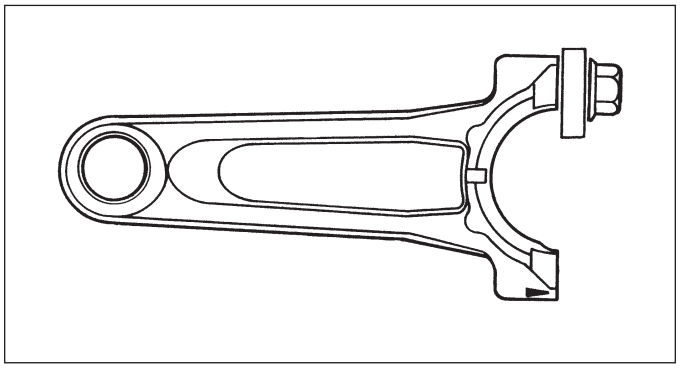
### FLYWHEEL HOLDING TOOL



A flywheel holding tool can be made out of an old junk flywheel ring gear and used in place of a strap wrench.

1. Using an abrasive cut-off wheel, cut out a six tooth segment of ring gear as shown.
2. Grind off any burrs or sharp edges.
3. Invert segment and place it between ignition bosses on crankcase so tool teeth engage flywheel ring gear teeth. Bosses will lock tool and flywheel in position for loosening, tightening, or removing with a puller.

### ROCKER ARM/CRANKSHAFT TOOL



A spanner wrench to lift rocker arms or turn crankshaft may be made out of an old junk connecting rod.

1. Find a used connecting rod from a 10 HP or larger engine. Remove and discard rod cap.
2. Remove studs of a Posi-Lock rod or grind off aligning steps of a Command rod, so joint surface is flat.
3. Find a 1 in. long capscrew with correct thread size to match threads in connecting rod.
4. Use a flat washer with correct I.D. to slip on capscrew and approximately 1 in. O.D**.** Assemble capscrew and washer to joint surface of rod.

## TROUBLESHOOTING GUIDE

When troubles occur, be sure to check simple causes which, at first, may seem too obvious to be considered. For example, a starting problem could be caused by an empty fuel tank.

Some general common causes of engine troubles are listed below and vary by engine specification. Use these to locate causing factors.

### Engine Cranks But Will Not Start

- Battery connected backwards.
- Blown fuse.
- Carburetor solenoid malfunction.
- Choke not closing.
- Clogged fuel line or fuel filter.
- Diode in wiring harness failed in open circuit mode.
- DSAI or DSAM malfunction.
- Empty fuel tank.
- Faulty electronic control unit.
- Faulty ignition coil(s).
- Faulty spark plug(s).
- Fuel pump malfunction-vacuum hose clogged or leaking.
- Fuel shut-off valve closed.
- Ignition module(s) faulty or improperly gapped.
- Insufficient voltage to electronic control unit.
- Interlock switch is engaged or faulty.
- Key switch or kill switch in OFF position.
- Low oil level.
- Quality of fuel (dirt, water, stale, mixture).
- SMART-SPARK$_{TM}$ malfunction.
- Spark plug lead(s) disconnected.

### Engine Starts But Does Not Keep Running

- Faulty carburetor.
- Faulty cylinder head gasket.
- Faulty or misadjusted choke or throttle controls.
- Fuel pump malfunction-vacuum hose clogged or leaking.
- Intake system leak.
- Loose wires or connections that intermittently ground ignition kill circuit.
- Quality of fuel (dirt, water, stale, mixture).
- Restricted fuel tank cap vent.

### Engine Starts Hard

- Clogged fuel line or fuel filter.
- Engine overheated.
- Faulty ACR mechanism.
- Faulty or misadjusted choke or throttle controls.
- Faulty spark plug(s).
- Flywheel key sheared.
- Fuel pump malfunction-vacuum hose clogged or leaking.
- Interlock switch is engaged or faulty.
- Loose wires or connections that intermittently ground ignition kill circuit.
- Low compression.
- Quality of fuel (dirt, water, stale, mixture).
- Weak spark.

### Engine Will Not Crank

- Battery is discharged.
- Faulty electric starter or solenoid.
- Faulty key switch or ignition switch.
- Interlock switch is engaged or faulty.
- Loose wires or connections that intermittently ground ignition kill circuit.
- Pawls not engaging in drive cup.
- Seized internal engine components.

### Engine Runs But Misses

- Carburetor adjusted incorrectly.
- Engine overheated.
- Faulty spark plug(s).
- Ignition module(s) faulty or improperly gapped.
- Incorrect crankshaft position sensor air gap.
- Interlock switch is engaged or faulty.
- Loose wires or connections that intermittently ground ignition kill circuit.
- Quality of fuel (dirt, water, stale, mixture).
- Spark plug lead(s) disconnected.
- Spark plug lead boot loose on plug.
- Spark plug lead loose.

### Engine Will Not Idle

- Engine overheated.
- Faulty spark plug(s).
- Idle fuel adjusting needle(s) improperly set.
- Idle speed adjusting screw improperly set.
- Inadequate fuel supply.
- Low compression.
- Quality of fuel (dirt, water, stale, mixture).
- Restricted fuel tank cap vent.

### Engine Overheats

- Cooling fan broken.
- Excessive engine load.
- Fan belt failed/off.
- Faulty carburetor.
- High crankcase oil level.
- Lean fuel mixture.
- Low cooling system fluid level.
- Low crankcase oil level.
- Radiator, and/or cooling system components clogged, restricted, or leaking.
- Water pump belt failed/broken.
- Water pump malfunction.

### Engine Knocks

- Excessive engine load.
- Hydraulic lifter malfunction.
- Incorrect oil viscosity/type.
- Internal wear or damage.
- Low crankcase oil level.
- Quality of fuel (dirt, water, stale, mixture).

### Engine Loses Power

- Dirty air cleaner element.
- Engine overheated.
- Excessive engine load.
- Restricted exhaust.
- Faulty spark plug(s).
- High crankcase oil level.
- Incorrect governor setting.
- Low battery.
- Low compression.
- Low crankcase oil level.
- Quality of fuel (dirt, water, stale, mixture).

### Engine Uses Excessive Amount of Oil

- Loose or improperly torqued fasteners.
- Blown head gasket/overheated.
- Breather reed broken.
- Clogged, broken, or inoperative crankcase breather.
- Crankcase overfilled.
- Incorrect oil viscosity/type.
- Worn cylinder bore.
- Worn or broken piston rings.
- Worn valve stems/valve guides.

### Oil Leaks from Oil Seals, Gaskets

- Breather reed broken.
- Clogged, broken, or inoperative crankcase breather.
- Loose or improperly torqued fasteners.
- Piston blow by, or leaky valves.
- Restricted exhaust.

### EXTERNAL ENGINE INSPECTION

NOTE: It is good practice to drain oil at a location away from workbench. Be sure to allow ample time for complete drainage.

Before cleaning or disassembling engine, make a thorough inspection of its external appearance and condition. This inspection can give clues to what might be found inside engines (and cause) when it is disassembled.

- Check for buildup of dirt and debris on crankcase, cooling fins, grass screen, and other external surfaces. Dirt or debris on these areas can cause overheating.
- Check for obvious fuel and oil leaks, and damaged components. Excessive oil leakage can indicate a clogged or inoperative breather, worn or damaged seals or gaskets, or loose fasteners.
- Check air cleaner cover and base for damage or indications of improper fit and seal.
- Check air cleaner element. Look for holes, tears, cracked or damaged sealing surfaces, or other damage that could allow unfiltered air into engine. A dirty or clogged element could indicate insufficient or improper maintenance.
- Check carburetor throat for dirt. Dirt in throat is further indication that air cleaner was not functioning properly.
- Check if oil level is within operating range on dipstick. If it is above, sniff for gasoline odor.
- Check condition of oil. Drain oil into a container; it should flow freely. Check for metal chips and other foreign particles.

  Sludge is a natural by-product of combustion; a small accumulation is normal. Excessive sludge formation could indicate over rich fuel settings, weak ignition, overextended oil change interval or wrong weight or type of oil was used.

### CLEANING ENGINE

|  | **⚠ WARNING** |
|---|---|
| | Cleaning Solvents can cause severe injury or death.<br>Use only in well ventilated areas away from ignition sources. |
| Carburetor cleaners and solvents are extremely flammable. Follow cleaner manufacturer's warnings and instructions on its proper and safe use. Never use gasoline as a cleaning agent. | |

After inspecting external condition of engine, clean engine thoroughly before disassembly. Clean individual components as engine is disassembled. Only clean parts can be accurately inspected and gauged for wear or damage. There are many commercially available cleaners that will quickly remove grease, oil, and grime from engine parts. When such a cleaner is used, follow manufacturer's instructions and safety precautions carefully.

Make sure all traces of cleaner are removed before engine is reassembled and placed into operation. Even small amounts of these cleaners can quickly break down lubricating properties of engine oil.

**CRANKCASE VACUUM TEST**

**⚠ WARNING**

Carbon Monoxide can cause severe nausea, fainting or death.

Avoid inhaling exhaust fumes.

Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled.

**⚠ WARNING**

Rotating Parts can cause severe injury.

Stay away while engine is in operation.

Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate engine with covers, shrouds, or guards removed.

A partial vacuum should be present in crankcase when engine is operating. Pressure in crankcase (normally caused by a clogged or improperly assembled breather) can cause oil to be forced out at oil seals, gaskets, or other available spots.

Crankcase vacuum is best measured with either a water manometer or a vacuum gauge. Complete instructions are provided in kits.

To test crankcase vacuum with manometer:

1. Insert rubber stopper into oil fill hole. Be sure pinch clamp is installed on hose and use tapered adapters to connect hose between stopper and one manometer tube. Leave other tube open to atmosphere. Check that water level in manometer is at 0 line. Make sure pinch clamp is closed.
2. Start engine and run no-load high speed.
3. Open clamp and note water level in tube.

   Level in engine side should be a minimum of 10.2 cm (4 in.) above level in open side.

   If level in engine side is less than specified (low/no vacuum), or level in engine side is lower than level in open side (pressure), check for conditions in table below.
4. Close pinch clamp before stopping engine.

To test crankcase vacuum with vacuum/pressure gauge:

1. Remove dipstick or oil fill plug/cap.
2. Install adapter into oil fill//dipstick tube opening, upside down over end of a small diameter dipstick tube, or directly into engine if a tube is not used. Insert barbed gauge fitting into hole in stopper.
3. Run engine and observe gauge reading.

   Analog tester–needle movement to left of 0 is a vacuum, and movement to right indicates a pressure.

   Digital tester–depress test button on top of tester.

   Crankcase vacuum should be a minimum of 10.2 cm (4 in.) of water. If reading is below specification, or if pressure is present, check table below for possible causes and conclusions.

| Condition | Conclusion |
|---|---|
| Crankcase breather clogged or inoperative. | NOTE: If breather is integral part of valve cover and cannot be serviced separately, replace valve cover and recheck pressure.<br>Disassemble breather, clean parts thoroughly, check sealing surfaces for flatness, reassemble, and recheck pressure. |
| Seals and/or gaskets leaking. Loose or improperly torque fasteners. | Replace all worn or damaged seals and gaskets. Make sure all fasteners are tightened securely. Use appropriate torque valves and sequences when necessary. |
| Piston blow by or leaky valves (confirm by inspecting components). | Recondition piston, rings, cylinder bore, valves and valves guides. |
| Restricted exhaust. | Check exhaust screen/spark arrestor (if equipped). Clean or replace as needed. Repair or replace any other damaged/restricted muffler or exhaust system parts. |

### COMPRESSION TEST

For Command Twins:

A compression test is best performed on a warm engine. Clean any dirt or debris away from base of spark plug(s) before removing them. Be sure choke is off, and throttle is wide open during test. Compression should be at least 160 psi and should not vary more than 15% between cylinders.

All other models:

These engines are equipped with an automatic compression release (ACR) mechanism. It is difficult to obtain an accurate compression reading because of ACR mechanism. As an alternative, use cylinder leakdown test described below.

### CYLINDER LEAKDOWN TEST

A cylinder leakdown test can be a valuable alternative to a compression test. By pressurizing combustion chamber from an external air source you can determine if valves or rings are leaking, and how badly.

Cylinder leakdown tester is a relatively simple, inexpensive leakdown tester for small engines. This tester includes a quick-connect for attaching adapter hose and a holding tool.

1. Run engine for 3-5 minutes to warm it up.
2. Remove spark plug(s) and air filter from engine.
3. Rotate crankshaft until piston (of cylinder being tested) is at top dead center (TDC) of compression stroke. Hold engine in this position while testing. Holding tool supplied with tester can be used if PTO end of crankshaft is accessible. Lock holding tool onto crankshaft. Install a 3/8 in. breaker bar into hole/slot of holding tool, so it is perpendicular to both holding tool and crankshaft PTO.

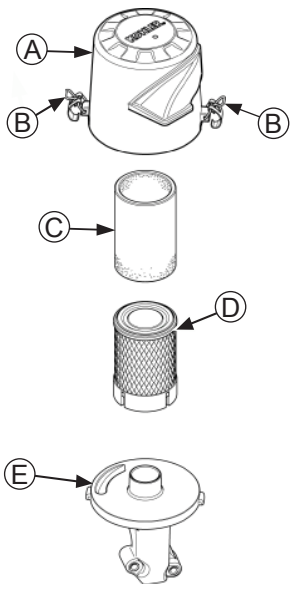
   If flywheel end is more accessible, use a breaker bar and socket on flywheel nut/screw to hold it in position. An assistant may be needed to hold breaker bar during testing. If engine is mounted in a piece of equipment, it may be possible to hold it by clamping or wedging a driven component. Just be certain that engine cannot rotate off of TDC in either direction.
4. Install adapter into spark plug hole, but do not attach it to tester at this time.
5. Turn regulator knob completely counterclockwise.
6. Connect an air source of at least 50 psi to tester.
7. Turn regulator knob clockwise (increase direction) until gauge needle is in yellow set area at low end of scale.
8. Connect tester quick-connect to adapter hose. While firmly holding engine at TDC, gradually open tester valve. Note gauge reading and listen for escaping air at combustion air intake, exhaust outlet, and crankcase breather.

| Condition | Conclusion |
|---|---|
| Air escaping from crankcase breather. | Ring or cylinder worn. |
| Air escaping from exhaust system. | Defective exhaust valve/improper seating. |
| Air escaping from intake. | Defective intake valve/improper seating. |
| Gauge reading in low (green) zone. | Piston rings and cylinder in good condition. |
| Gauge reading in moderate (yellow) zone. | Engine is still usable, but there is some wear present. Customer should start planning for overhaul or replacement. |
| Gauge reading in high (red) zone. | Rings and/or cylinder have considerable wear. Engine should be reconditioned or replaced. |

## AIR CLEANER

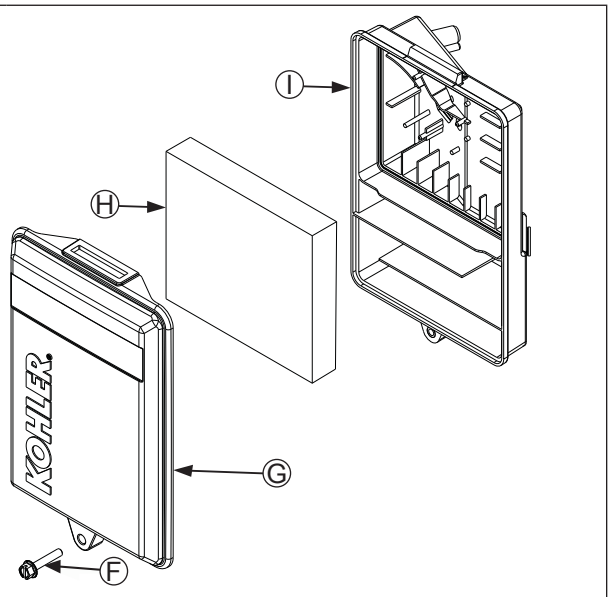
These systems are CARB/EPA certified and components should not be altered or modified in any way.

**Quad-Clean™ Air Cleaner Components**




| | | | |
|---|---|---|---|
| **A** | Air Cleaner Cover | **B** | Bail |
| **C** | Precleaner | **D** | Paper Element |
| **E** | Air Cleaner Base | | |

**Low-Profile Air Cleaner Components**




| | | | |
|---|---|---|---|
| **F** | Screw | **G** | Air Cleaner Cover |
| **H** | Foam Element | **I** | Air Cleaner Base |

NOTE: Running engine with cover positioned for cold weather operation in normal conditions can damage engine.

NOTE: Operating engine with loose or damaged air cleaner components could cause premature wear and failure. Replace all bent or damaged components.

NOTE: Paper element cannot be blown out with compressed air.

### Quad-Clean™

Move bails on air cleaner cover down; remove latches from under tabs on base; remove cover.

**Precleaner**

1. Remove precleaner from paper element.
2. Replace or wash precleaner in warm water with detergent. Rinse and allow to air dry.
3. Lightly oil precleaner with new engine oil; squeeze out excess oil.
4. Reinstall precleaner over paper element.

**Paper Element**

1. Separate precleaner from element; service precleaner and replace paper element.
2. Install new paper element on base; install precleaner over paper element.

Position air cleaner cover for normal operation (sun decal out) or cold weather operation (snowflake decal out); place latches under tabs on base; lift up bails to secure cover.

### Low-Profile

1. Remove screw and air cleaner cover.
2. Remove foam element from base.
3. Wash foam element in warm water with detergent. Rinse and allow to air dry.
4. Lightly oil foam element with new engine oil; squeeze out excess oil.
5. Reinstall foam element into base.
6. Reinstall cover and secure with screw.

## BREATHER TUBE

Ensure both ends of breather tube are properly connected.

## AIR COOLING

| | |
|---|---|
|  | **⚠ WARNING**<br>Hot Parts can cause severe burns.<br>Do not touch engine while operating or just after stopping. |
| Never operate engine with heat shields or guards removed. | |

Proper cooling is essential. To prevent over heating, clean screens, cooling fins, and other external surfaces of engine. Avoid spraying water at wiring harness or any electrical components. Refer to Maintenance Schedule.

# Fuel System

Typical carbureted fuel system and related components include:

- Fuel tank.
- Fuel lines.
- In-line fuel filter.
- Fuel tank filter.
- Carburetor.
- Fuel strainer screen in carburetor.

### FUEL RECOMMENDATIONS

Refer to Maintenance.

### FUEL LINE

Low permeation fuel line must be installed on carbureted Kohler Co. engines to maintain EPA and CARB regulatory compliance.

### FUEL FILTER

#### Fuel Tank Filter (if equipped)

A serviceable fuel tank filter is located under fuel tank cap, in filler neck.

Daily or as required clean filter of any accumulation as follows:

1. Remove fuel tank cap and filter.
2. Clean filter with solvent, replace if damaged.
3. Wipe filter and insert it.
4. Tighten fuel tank cap securely.

#### Fuel Valve

**⚠ WARNING**

Explosive Fuel can cause fires and severe burns.

Do not fill fuel tank while engine is hot or running.

Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Never use gasoline as a cleaning agent.

NOTE: Models with a low-profile air cleaner do not have fuel valve.

1. Stop engine.
2. Remove securing hardware and carburetor cover panel.
3. Turn fuel valve lever to OFF position.
4. Remove fuel valve cup.
5. Clean fuel valve cup with solvent and wipe it off.
6. Check O-ring, replace if damaged. Check screen for blockage or damage, replace if necessary. New screen must be located on pick-up tube.
7. Place O-ring on screen followed by fuel valve cup. Rotate fuel valve cup until it is finger tight. Turn with a wrench 1/2 to 3/4 turn.
8. Turn fuel valve to ON position and check for leaks. If fuel valve cup leaks repeat step 7.
9. Reinstall carburetor cover panel, using hardware removed in step 2 to secure.

### FUEL SYSTEM TESTS

When engine starts hard, or turns over but will not start, fuel system might be causing problems. Test fuel system by performing following test.

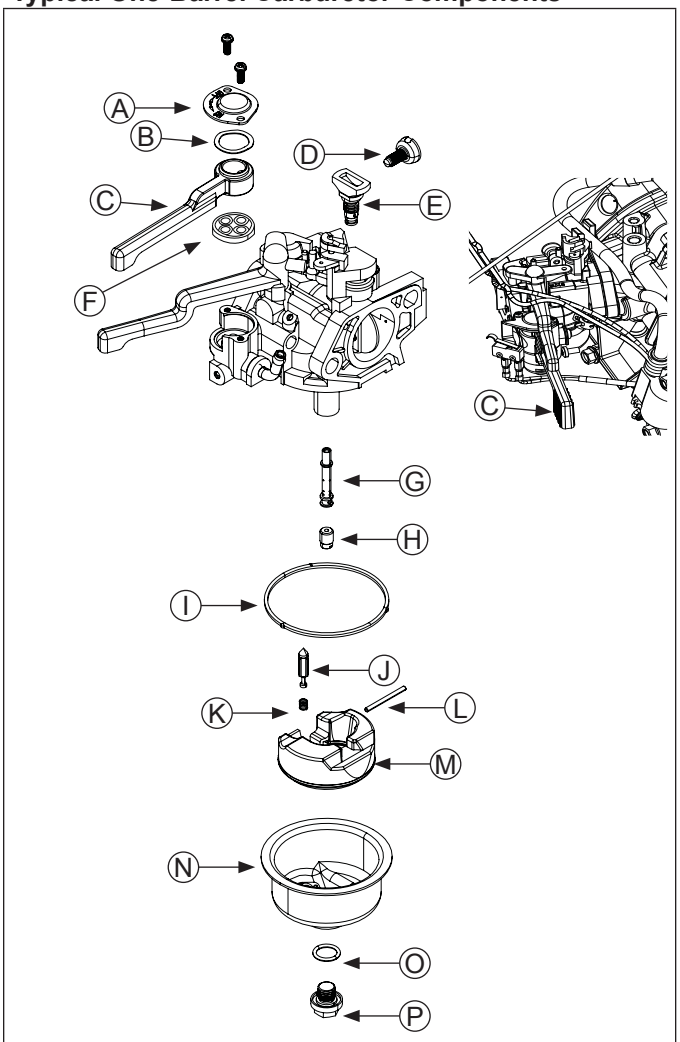
1. Check for fuel in combustion chamber.
   a. Disconnect and ground spark plug lead.
   b. Close choke on carburetor.
   c. Crank engine several times.
   d. Remove spark plug and check for fuel at tip.
2. Check for fuel flow from tank to carburetor.
   a. Remove fuel line from inlet fitting of carburetor.
   b. Use an approved fuel container to catch fuel, and hold line below bottom of tank to observe fuel flow.
3. Check operation of fuel shut-off valve.
   a. Remove fuel sediment bowl under inlet fitting of carburetor.
   b. Turn fuel shut-off valve ON and OFF and observe operation.

| Condition | Conclusion |
|---|---|
| Fuel at tip of spark plug. | Fuel is reaching combustion chamber. |
| No fuel at tip of spark plug. | Check fuel flow from fuel tank (step 2). |
| Fuel flows from fuel line. | Check operation of fuel shut-off valve (step 3). |
| No fuel flow from fuel line. | Check fuel tank vent, in-line filter threaded into tank, and fuel line. Correct any observed problem and reconnect line. |
| Fuel flows from valve. | Check for dirt and water in sediment bowl and screen. Clean bowl and screen as needed. Check for faulty carburetor, refer to Carburetor. |
| No fuel flows from valve. | Check for a restriction in fuel shut-off valve or inlet elbow. |

## CARBURETOR

| | | |
|---|---|---|
|  | **⚠ WARNING**<br>Explosive Fuel can cause fires and severe burns.<br>Do not fill fuel tank while engine is hot or running. | Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Never use gasoline as a cleaning agent. |

**Typical One-Barrel Carburetor Components**




| | | | |
|---|---|---|---|
| **A** | Fuel Shut-Off | **B** | Wave Washer |
| **C** | Fuel Shut-Off (and Ignition, if equipped) | **D** | Low Idle Speed Adjusting Screw |
| **E** | Idle Jet | **F** | Fuel Shut-Off Gasket |
| **G** | Main Nozzle Tube | **H** | Main Jet |
| **I** | Bowl Gasket | **J** | Fuel Inlet Needle |
| **K** | Spring | **L** | Hinge Pin |
| **M** | Float | **N** | Fuel Bowl |
| **O** | Bowl Retaining Screw Gasket | **P** | Bowl Retaining Screw |

These engines are equipped with a fixed main jet carburetor. Carburetor is designed to deliver correct fuel-to-air mixture to engine under all operating conditions. Idle mixture is set at factory and cannot be adjusted.

### Troubleshooting Checklist

When engine starts hard, runs rough, or stalls at low idle speed, check these areas before adjusting or disassembling carburetor.

1. Make sure fuel tank is filled with clean, fresh gasoline.
2. Make sure fuel tank cap vent is not blocked and is operating properly.
3. Make sure fuel is reaching carburetor. This includes checking fuel shut-off valve, fuel tank filter screen, in-line fuel filter, fuel lines and fuel pump for restrictions or faulty components as necessary.
4. Make sure air cleaner base and carburetor are securely fastened to engine using gaskets in good condition.
5. Make sure air cleaner element (including precleaner if equipped) is clean and all air cleaner components are fastened securely.
6. Make sure ignition system, governor system, exhaust system, and throttle and choke controls are operating properly.

### Troubleshooting-Carburetor Related Causes

| Condition | Possible Cause | Conclusion |
|---|---|---|
| Engine starts hard, runs rough, or stalls at idle speed. | Low idle fuel mixture (some models)/ speed improperly adjusted. | Adjust idle speed screw or clean carburetor. |
| Engine runs rich (indicated by black, sooty exhaust smoke, misfiring, loss of speed and power, governor hunting, or excessive throttle opening). | Clogged air cleaner. | Clean or replace air cleaner. |
| | Choke partially closed during operation. | Check choke lever/linkage to ensure choke is operating properly. |
| | Dirt under fuel inlet needle. | Remove needle; clean needle and seat and blow with compressed air. |
| | Bowl vent or air bleeds plugged. | Clean vent, ports, and air bleeds. Blow out all passages with compressed air. |
| | Leaky, cracked, or damaged float. | Submerge float to check for leaks. |
| Engine runs lean (indicated by misfiring, loss of speed and power, governor hunting, or excessive throttle opening). | Intake air leak. | Check if carburetor is loose or one of intake gaskets is leaking. |
| | Idle holes plugged; dirt in fuel delivery channels. | Clean main fuel jet and all passages; blow out with compressed air. |
| Fuel leaks from carburetor. | Float damaged. | Submerge float to check for leaks. Replace float. |
| | Dirt under fuel inlet needle. | Remove needle; clean needle and seat and blow with compressed air. |
| | Bowl vents plugged. | Blow out with compressed air. |
| | Carburetor bowl gasket leaks. | Replace gasket. |

### Carburetor Circuits

**Float**
Fuel level in bowl is maintained by float and fuel inlet needle. Buoyant force of float stops fuel flow when engine is at rest. When fuel is being consumed, float will drop and fuel pressure will push inlet needle away from seat, allowing more fuel to enter bowl. When demand ceases, buoyant force of float will again overcome fuel pressure, rising to predetermined setting and stop flow.

**Slow and Mid-Range**
At low speeds engine operates only on slow circuit. As a metered amount of air is drawn through slow air bleed jets, fuel is drawn through main jet and further metered through slow jet. Air and fuel are mixed in body of slow jet and exit to idle progression (transfer port) chamber. From idle progression chamber, air fuel mixture is metered through idle port passage. At low idle air/fuel mixture is controlled by setting of idle fuel adjusting screws. This mixture is then mixed with main body of air and delivered to engine. As throttle plate opening increases, greater amounts of air/fuel mixture are drawn in through fixed and metered idle progression holes. As throttle plate opens further, vacuum signal becomes great enough at venturi so main circuit begins to work.

**Main (high-speed)**
At high speeds/loads engine operates on main circuit. As a metered amount of air is drawn through air jet, fuel is drawn through main jet. Air and fuel are mixed in main nozzles then enters main body of airflow where further mixing of fuel and air occurs. This mixture is then delivered to combustion chamber. Carburetor has a fixed main circuit; no adjustment is possible.

### Carburetor Adjustments

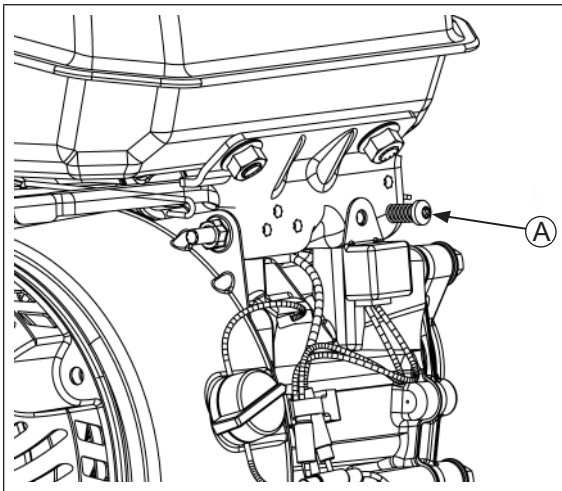
NOTE: Carburetor adjustments should be made only after engine has warmed up.

Carburetor is designed to deliver correct fuel-to-air mixture to engine under all operating conditions. Main fuel jet is calibrated at factory and is not adjustable. Idle fuel adjusting needles are also set at factory and are not adjustable.

**Low Idle Speed (RPM) Adjustment**
NOTE: Actual low idle speed depends on application. Refer to equipment manufacturer's recommendations. Low idle speed for basic engines is 1800 RPM.

1. Place throttle control into idle or slow position. Turn low idle speed adjusting screw in or out to obtain allow idle speed of 1800 RPM (± 75 RPM).

**High Idle Speed (RPM) Adjustment**




| | |
|---|---|
| **A** | High Idle Speed Adjusting Stop Screw |

NOTE: High idle speed is also specified by equipment manufacturer. Set according to recommendations. High idle speed for basic engines is 3600 RPM (± 150 RPM).

1. Set high idle speed by turning high idle speed adjusting stop screw in or out. Do not exceed 3750 RPM.

**Carburetor Servicing**

**⚠ WARNING**

Accidental Starts can cause severe injury or death.

Disconnect and ground spark plug lead(s) before servicing.

Before working on engine or equipment, disable engine as follows: 1) Disconnect spark plug lead(s). 2) Disconnect negative (–) battery cable from battery.

NOTE: Main and slow jets are fixed and size specific and can be removed if required. Fixed jets for high altitudes are available.

- Inspect carburetor body for cracks, holes, and other wear or damage.
- Inspect float for cracks, holes, and missing or damaged float tabs. Check float hinge and shaft for wear or damage.
- Inspect fuel inlet needle and seat for wear or damage.

1. Perform removal procedures for appropriate air cleaner and carburetor outlined in Disassembly.
2. Clean exterior surfaces of dirt or foreign material before disassembling carburetor. Remove bowl retaining screws, and carefully separate fuel bowl from carburetor. Do not damage fuel bowl O-rings. Transfer any remaining fuel into an approved container. Save all parts. Fuel can also be drained prior to bowl removal by loosening/removing bowl drain screw.
3. Remove float pin and inlet needle. Seat for inlet needle is not serviceable and should not be removed.
4. Clean carburetor bowl and inlet seat areas as required.
5. Carefully remove main jet from carburetor. After main jet is removed, main nozzles can be removed through bottom of main towers. Note orientation/ direction of nozzles. End with 2 raised shoulders should be out/down adjacent to main jets.
6. Save parts for cleaning and reuse unless a jet kit is also being installed. Clean slow jets using compressed air or carburetor cleaner, do not use wire.

NOTE: There are 2 O-rings on body of idle jet.

Carburetor is now disassembled for appropriate cleaning and installation of parts in overhaul kit. See instructions provided with repair kits for more detailed information.

**High Altitude Operation**

Engines may require a high altitude carburetor kit to ensure correct engine operation at altitudes above 1219 meters (4000 ft.). To obtain high altitude kit information or to find a Kohler authorized dealer visit KohlerEngines.com or call1-800-544-2444 (U.S. and Canada).

This engine should be operated in its original configuration below 1219 meters (4000 ft.) as damage may occur if high altitude carburetor kit is installed and operated below 1219 meters (4000 ft.).

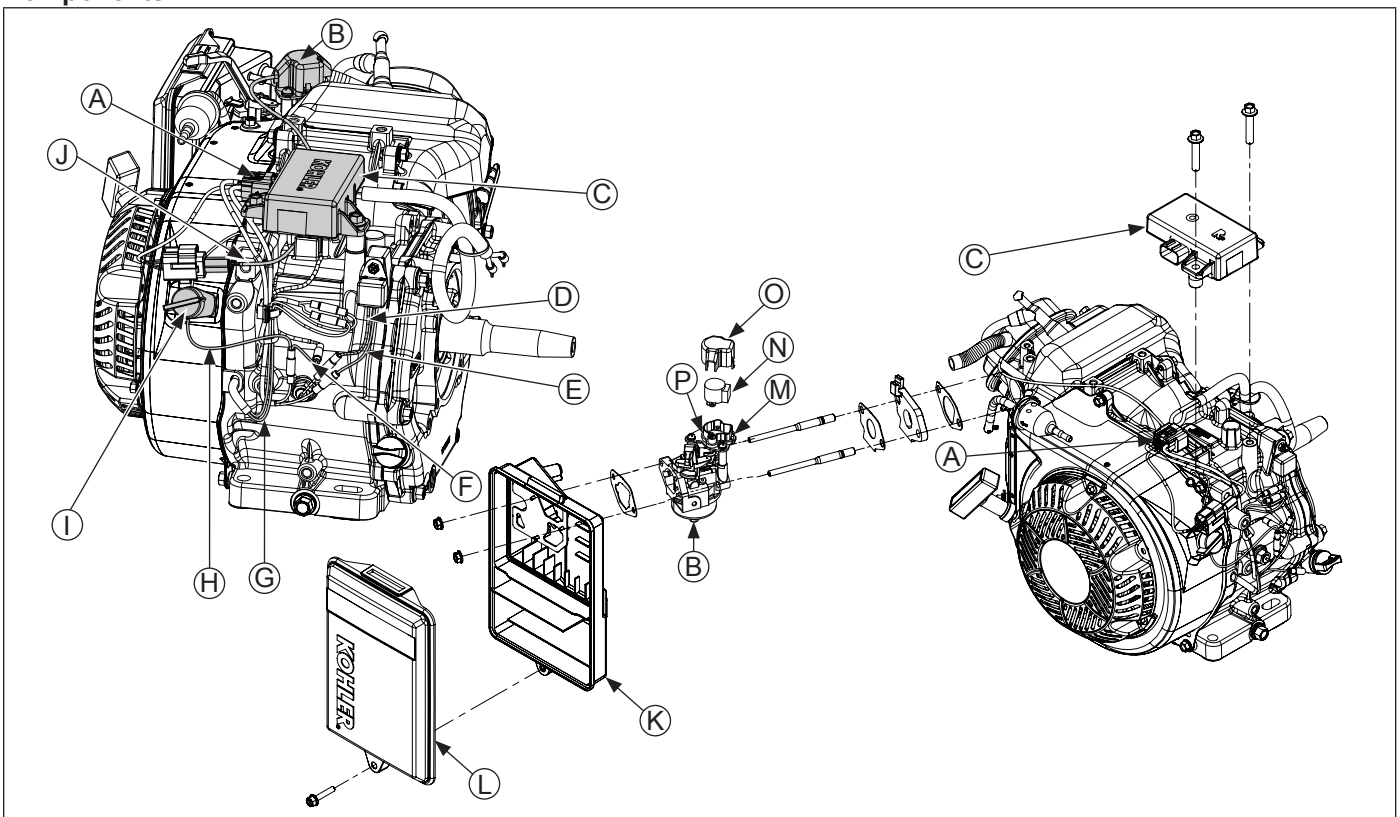
# Governor System

## GOVERNOR

These engines are equipped with an electronic governor or a mechanical governor.

## ELECTRONIC GOVERNOR

### Components

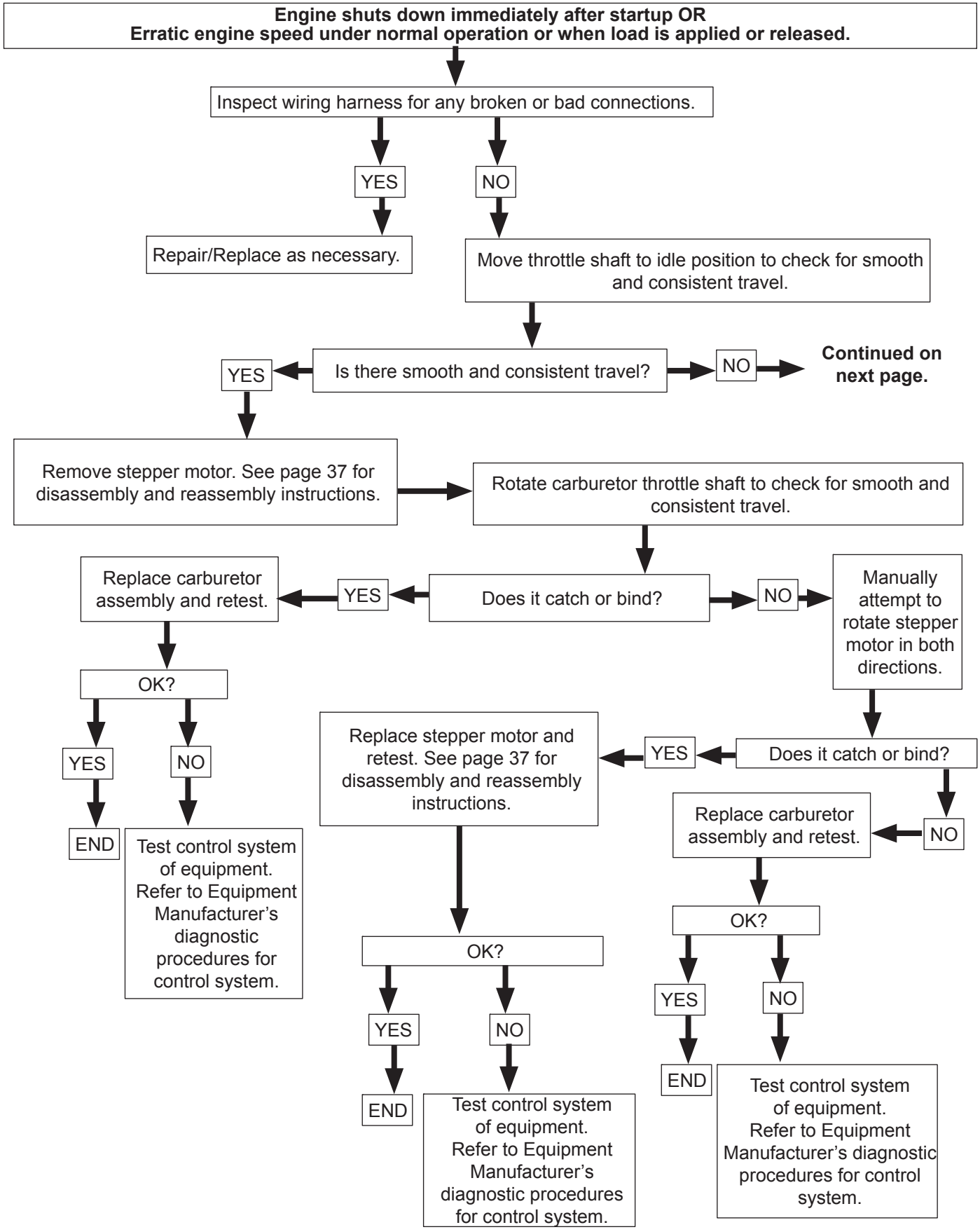



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **A** | Wiring Assembly Harness | **B** | Carburetor Assembly | **C** | Electronic Governor Control | **D** | Yellow Oil Sensor Lead to Oil Alert Green Lead |
| **E** | Green Lead from Electronic Governor Control to Oil Alert Black Lead | **F** | Ignition Switch Lead to Ignition Kill Lead | **G** | Red Leads from Electronic Governor Control to Red Stator Leads | **H** | White Lead from Electronic Governor Control to Ignition Switch |
| **I** | Ignition Switch | **J** | Carburetor Stepper Motor Leads to Electronic Governor Control Leads | **K** | Air Cleaner Base | **L** | Air Cleaner Cover |
| **M** | Stepper Motor Bracket | **N** | Stepper Motor | **O** | Stepper Motor Cover | **P** | Stepper Motor Base |

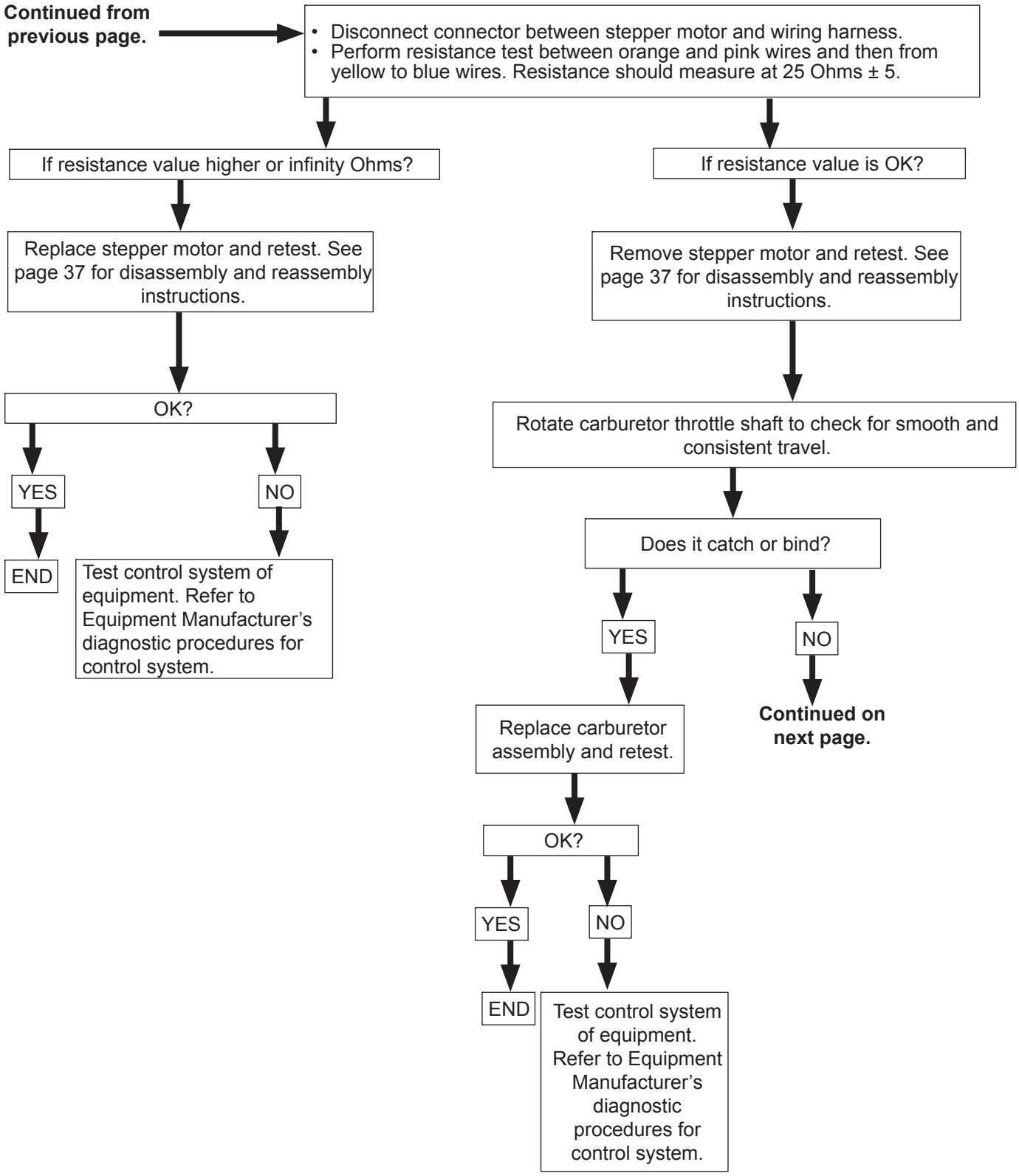
Electronic governor regulates engine speed at varying loads. This electronic governor includes:

- Electronic governor control.
- Stepper motor.
- Wiring assembly harness.

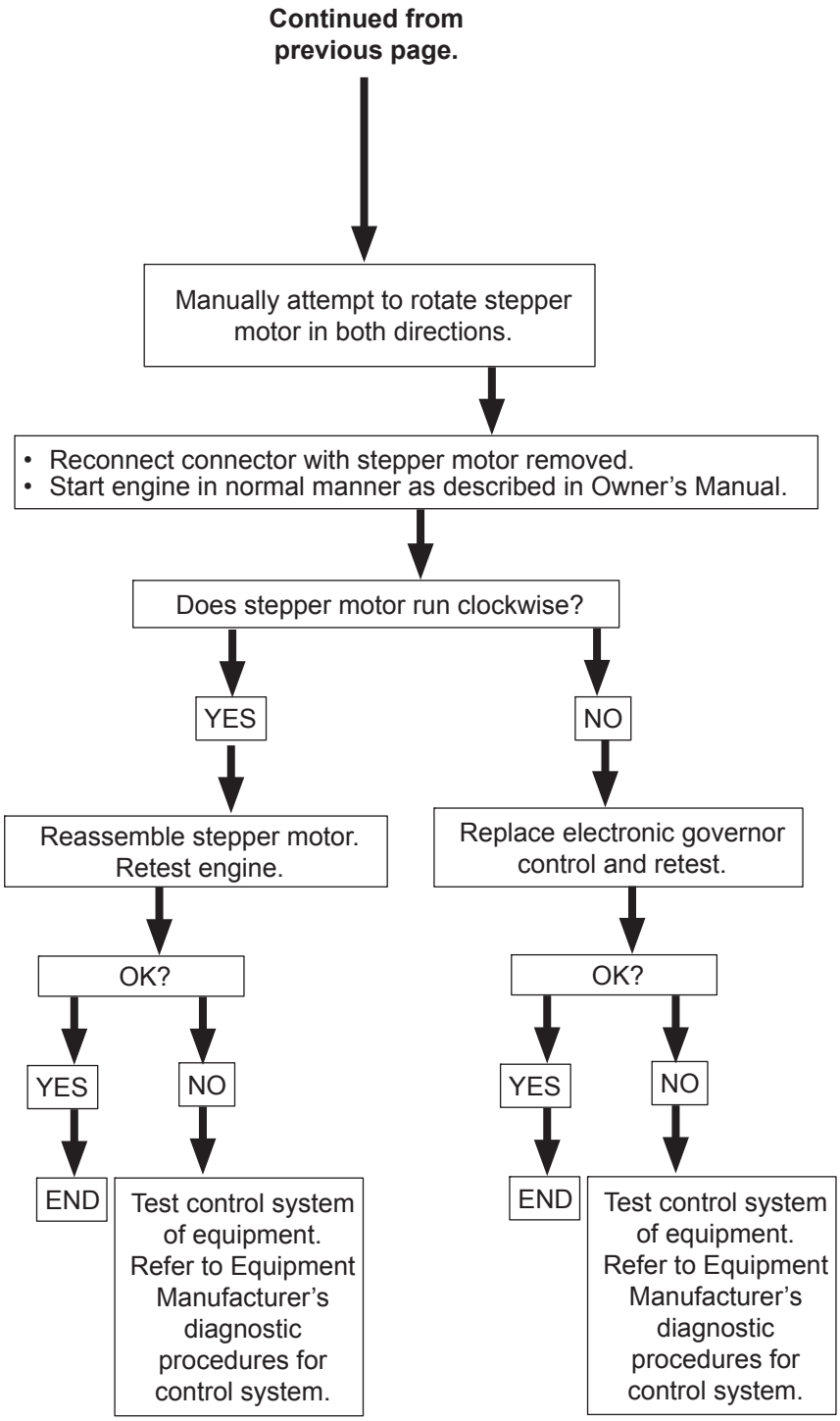
**Electronic Governor Troubleshooting Flow Chart**



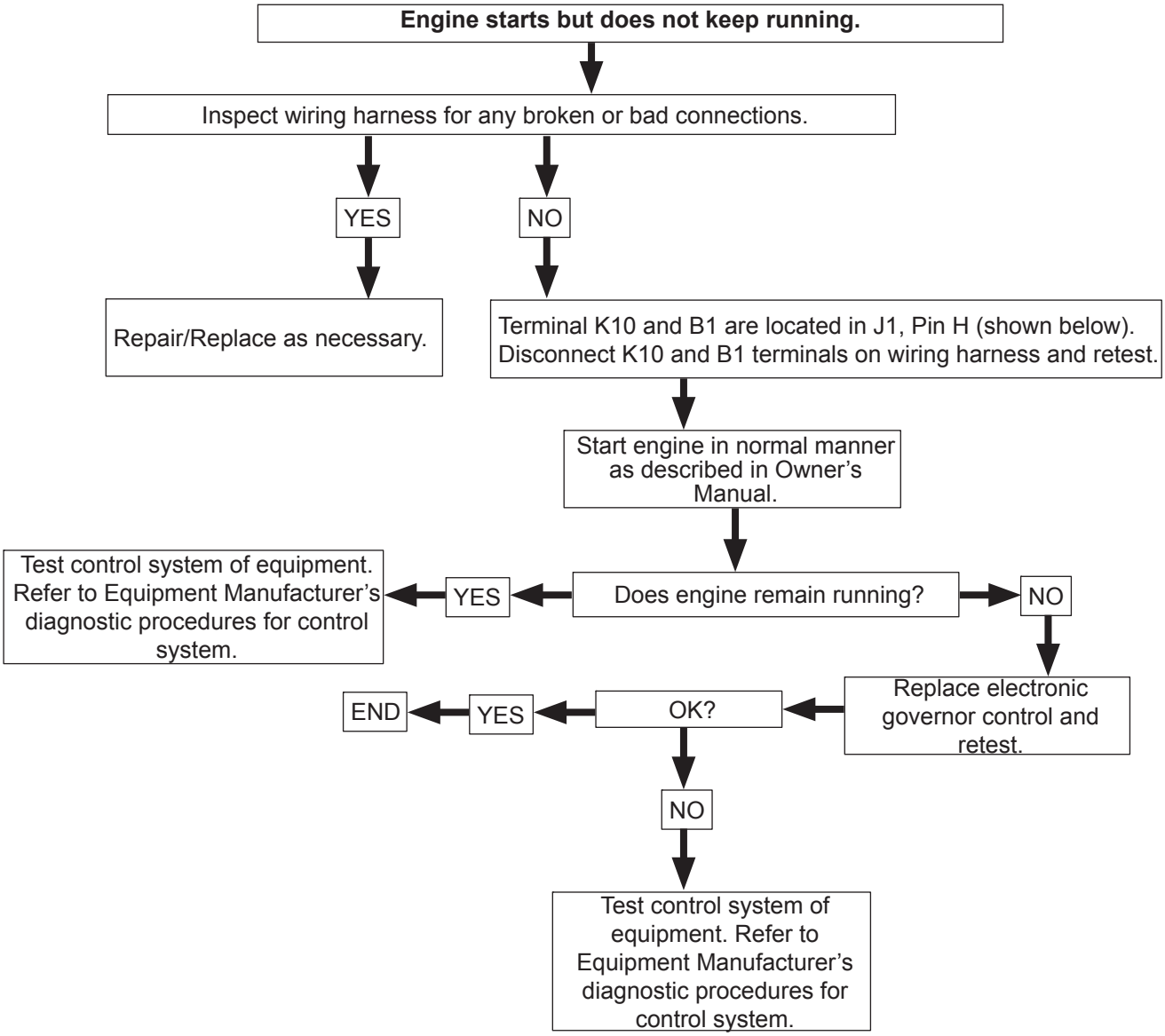
**Electronic Governor Troubleshooting Flow Chart Continued**



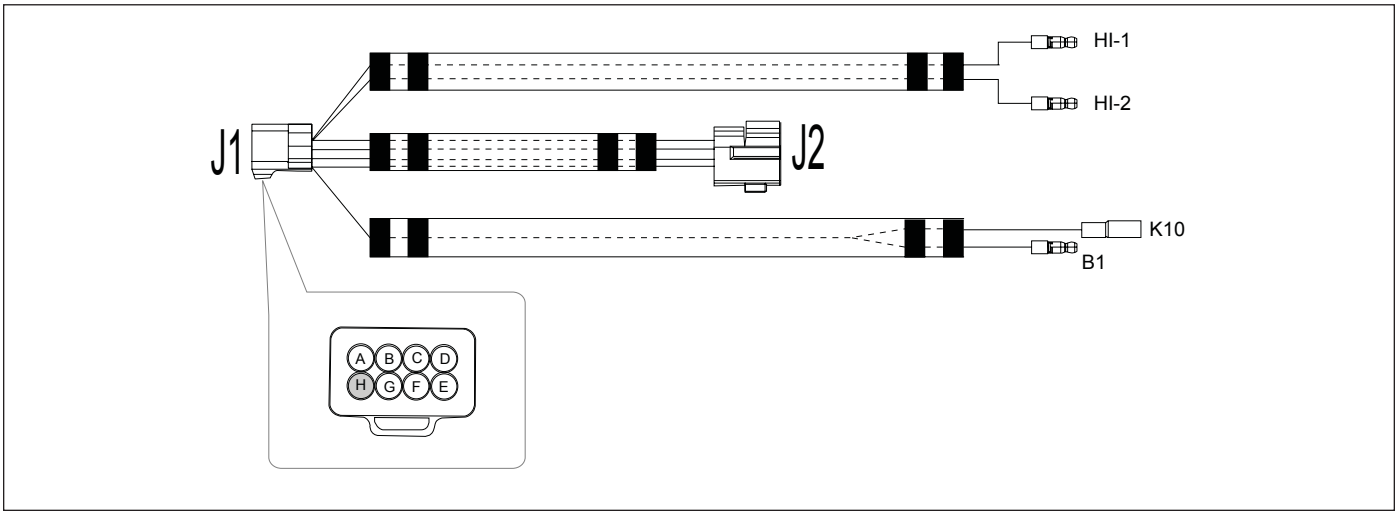
**Electronic Governor Troubleshooting Flow Chart Continued**



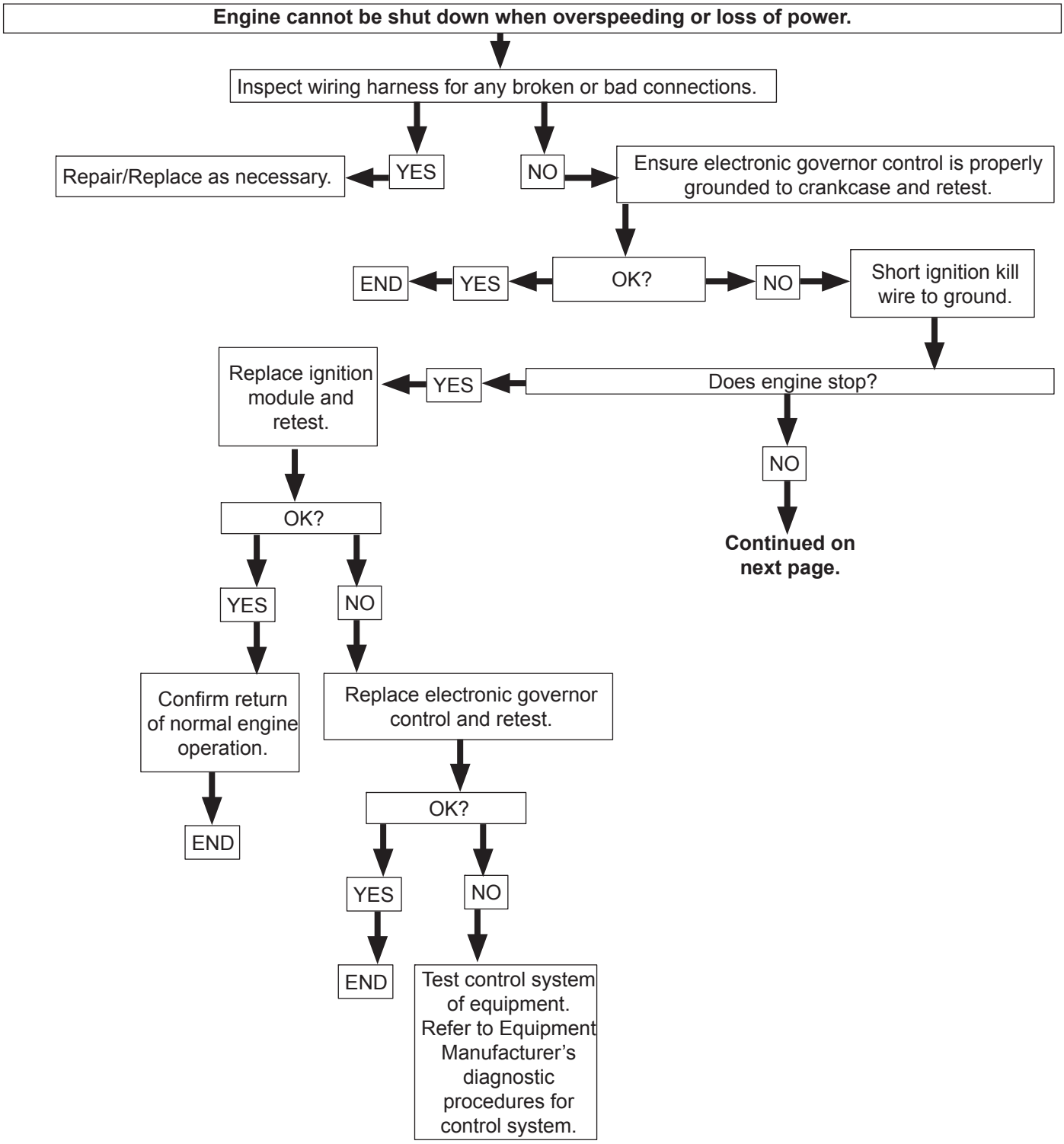
### Electronic Governor Troubleshooting Flow Chart Continued



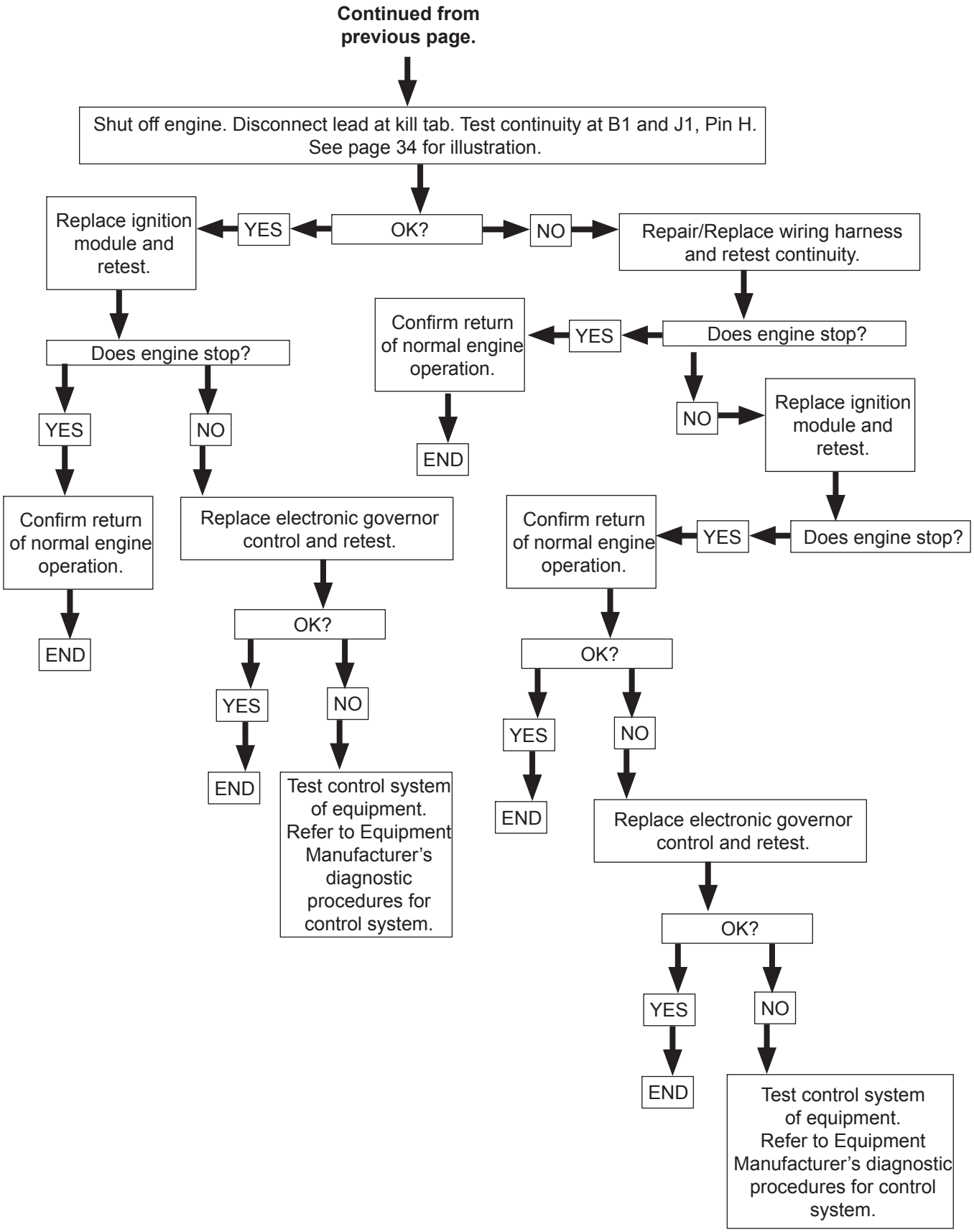

### Basic Wiring Harness Assembly Diagram



**Electronic Governor Troubleshooting Flow Chart Continued**

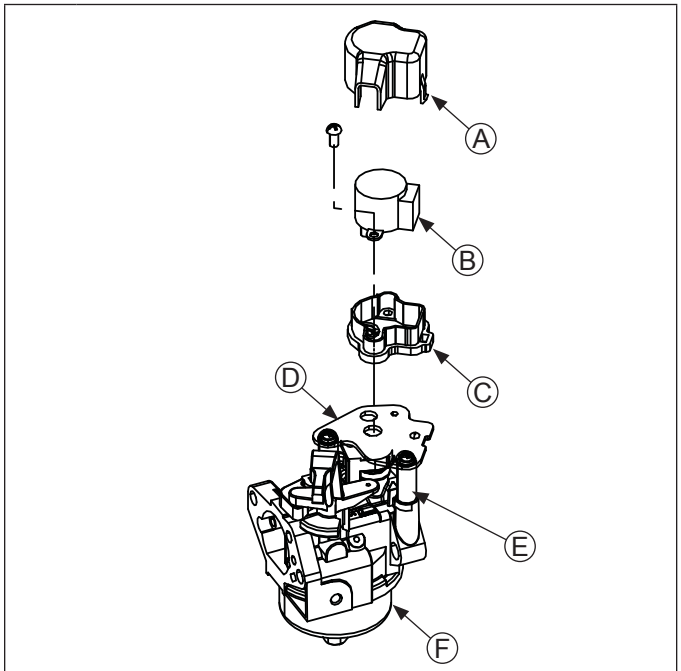


**Electronic Governor Troubleshooting Flow Chart Continued**



## Stepper Motor

### Stepper Motor Components




| | | | |
|---|---|---|---|
| **A** | Stepper Motor Cover | **B** | Stepper Motor |
| **C** | Stepper Motor Bracket | **D** | Stepper Motor Base |
| **E** | Stepper Motor Post | **F** | Carburetor |

### Stepper Motor Servicing

**Disassembly**

NOTE: It is not necessary to remove stepper motor base from carburetor assembly when replacing stepper motor.

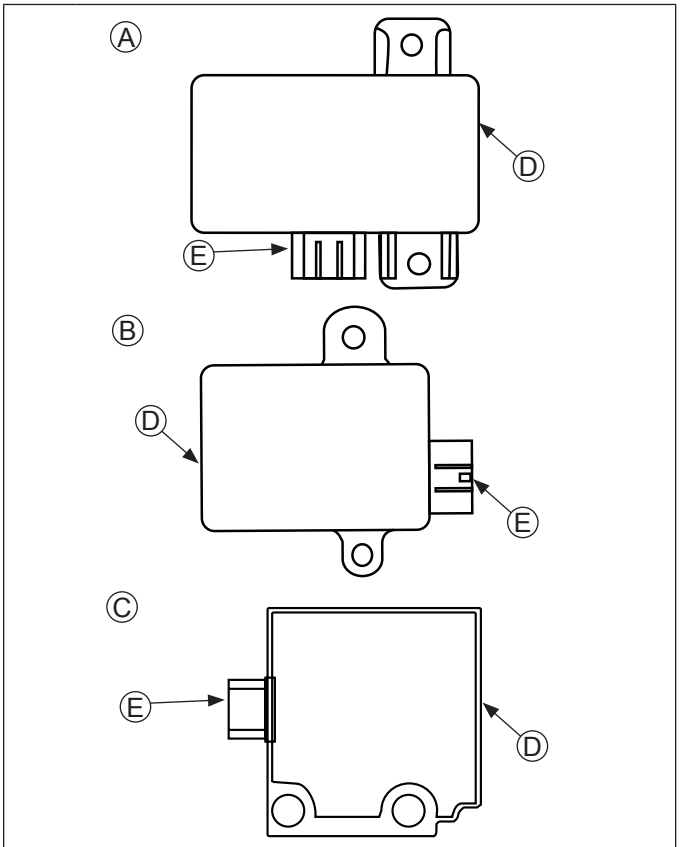
1. Disconnect connector between stepper motor and wiring harness.
2. Release clips on sides of stepper motor cover and remove cover.
3. Remove screw securing stepper motor to stepper motor bracket.
4. Remove stepper motor.

**Reassembly**

1. Install stepper motor into bracket and position on stepper motor base. Secure with screw and tighten.
2. Route wire harness so that it feeds through stepper motor cover. Install cover.
3. Reconnect connector between stepper motor and wiring harness.

## Electronic Governor Control

### Electronic Governor Control Components




| | | | |
|---|---|---|---|
| **A** | CH395 | **B** | CH440 |
| **C** | CH270 | **D** | Electronic Governor Control |
| **E** | Wiring Harness Connector | | |

### Electronic Governor Control Servicing

**Disassembly**

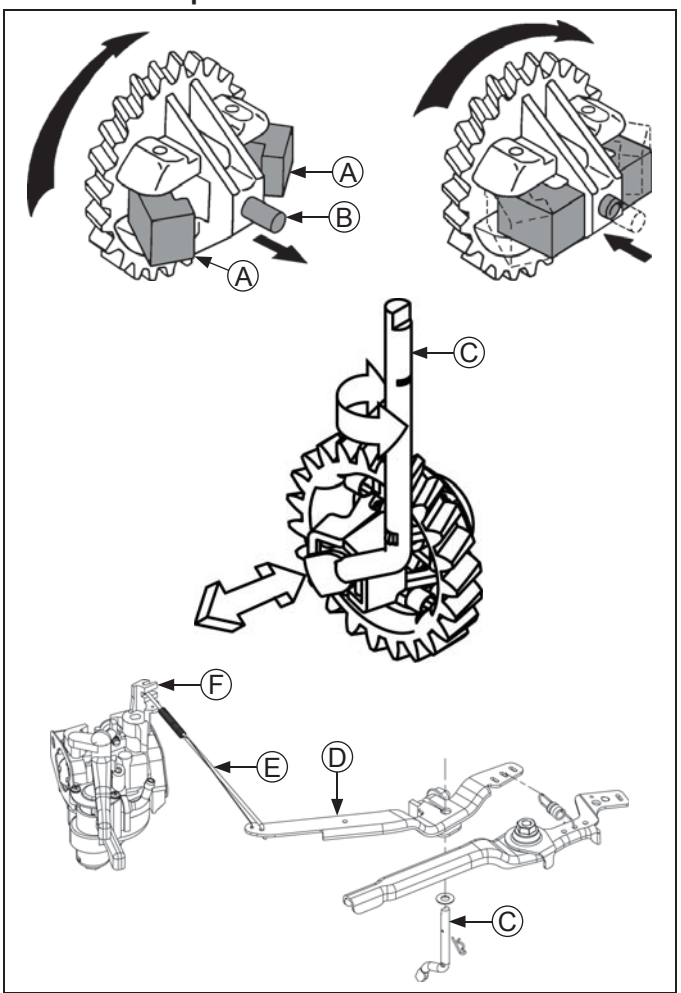
1. Mark wire locations and remove wires from control panel.
2. Remove wire harness from electronic governor control.
3. Remove screws securing electronic governor control to crankcase.

**Reassembly**

1. Place governor control in position on crankcase and secure with two screws. Torque screws to 24 N·m (212 in. lb.).
2. Install wires to control panel.
3. Install wiring harness to electronic governor control.

## MECHANICAL GOVERNOR

### Governor Components




| | | | |
|---|---|---|---|
| **A** | Flyweight | **B** | Regulating Pin |
| **C** | Cross Shaft | **D** | Governor Lever |
| **E** | Throttle Linkage | **F** | Throttle Lever |

Governed speed setting is determined by position of throttle control. It can be variable or constant, depending on engine application.

Governor is designed to hold engine speed constant under changing load conditions. Most engines are equipped with a centrifugal flyweight mechanical governor. Governor gear/flyweight mechanism of mechanical governor is mounted inside crankcase and is driven off gear on camshaft.

This governor design works as follows:

- Centrifugal force acting on rotating governor gear assembly causes flyweights to move outward as speed increases. Governor spring tension moves them inward as speed decreases.
- As flyweights move outward, they cause regulating pin to move outward.
- Regulating pin contacts tab on cross shaft causing shaft to rotate.
- One end of cross shaft protrudes through crankcase. Rotating action of cross shaft is transmitted to throttle lever of carburetor through external throttle linkage.
- When engine is at rest, and throttle is in fast position, tension of governor spring holds throttle plate open. When engine is operating, governor gear assembly is rotating. Force applied by regulating pin against cross shaft tends to close throttle plate. Governor spring tension and force applied by regulating pin balance each other during operation, to maintain engine speed.
- When load is applied and engine speed and governor gear speed decreases, governor spring tension moves governor arm to open throttle plate wider. This allows more fuel into engine, increasing engine speed. As speed reaches governed setting, governor spring tension and force applied by regulating pin will again offset each other to hold a steady engine speed.

### Governor Adjustments

NOTE: Make sure carburetor is mounted and secured in place when adjustment is being made/checked.

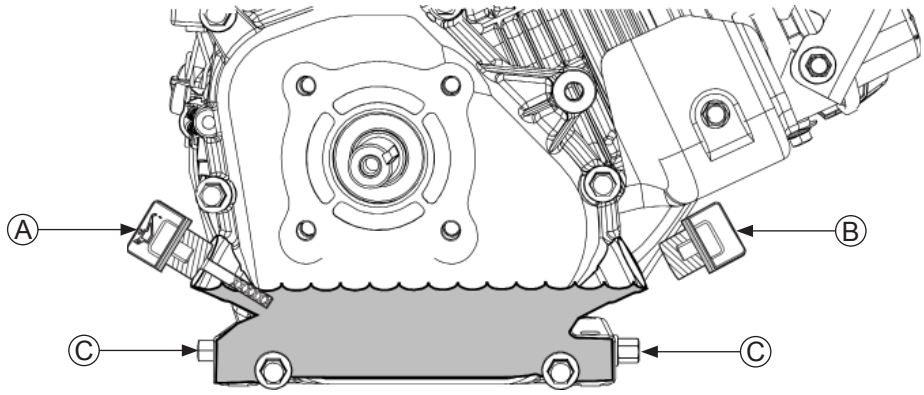
**Initial Adjustment Procedure**
Make this initial adjustment whenever governor lever is loosened or removed from cross shaft. To ensure proper setting, make sure throttle linkage is connected to governor lever and to carburetor throttle lever.

1. Close fuel shut-off valve.
2. Remove air cleaner outer cover. Then either reposition fuel tank to access governor cross shaft and lever joint, or disconnect fuel line and remove tank from engine.
3. Loosen governor lever mounting nut.
4. CH260, CH270: Move governor lever clockwise until it stops. Rotate governor cross shaft clockwise until it stops.

   CH395, CH440: Move governor lever counterclockwise until it stops. Rotate governor cross shaft counterclockwise until it stops.
5. Hold both in this position and torque governor lever nut to 12 N·m (106 in. lb.).

These engines use a splash lubrication system, supplying necessary lubrication to crankshaft, camshaft, connecting rod and valve train components.

**Lubrication Components**




| | | | | | |
|---|---|---|---|---|---|
| **A** | Dipstick | **B** | Oil Fill Plug | **C** | Oil Drain Plug |

**OIL RECOMMENDATIONS**

Refer to Maintenance.

**CHECK OIL LEVEL**

NOTE: To prevent extensive engine wear or damage, never run engine with oil level below or above operating range indicator on dipstick.

Ensure engine is cool. Clean oil fill/dipstick areas of any debris.

1. Remove dipstick; wipe oil off.
2. Reinsert dipstick into tube; rest on oil fill neck; turn counterclockwise until cap drops down to lowest point of thread leads; do not thread cap onto tube.
   a. Remove dipstick; check oil level. Level should be at top of indicator on dipstick.

   or

   b. Remove oil fill plug. Level should be up to point of overflowing filler neck.
3. If oil is low, add oil up to point of overflowing filler neck.
4. Reinstall dipstick or oil fill plug and tighten securely.

**CHANGE OIL**

Change oil while engine is warm.

1. Clean area around oil fill plug/dipstick and drain plug.
2. Remove drain plug and oil fill plug/dipstick. Drain oil completely.
3. Reinstall drain plug. Torque to 18 N·m (13 ft. lb.).
4. Fill crankcase with new oil, up to point of overflowing filler neck.
5. Reinstall oil fill plug/dipstick and tighten securely.
6. Dispose of used oil in accordance with local ordinances.

**OIL SENTRY™ (if equipped)**

This switch is designed to prevent engine from starting in a low oil or no oil condition. Oil Sentry™ may not shut down a running engine before damage occurs. In some applications this switch may activate a warning signal. Read your equipment manuals for more information. For testing procedures refer to Electronic Ignition Systems and Oil Sentry™ Tests.

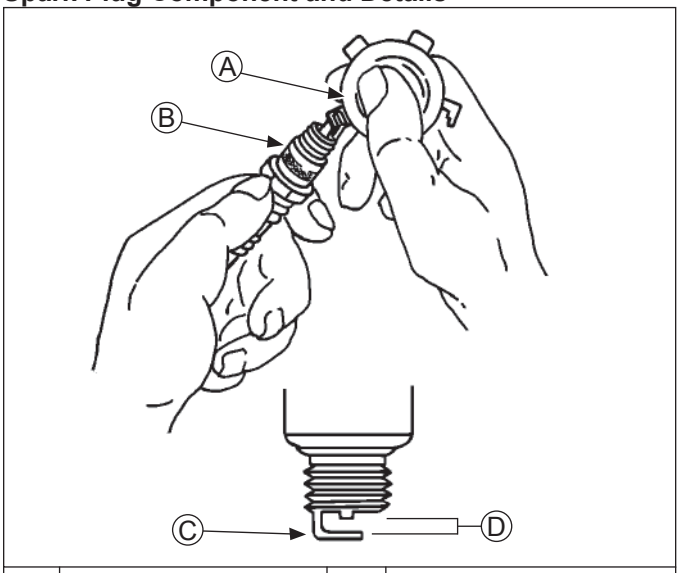
## SPARK PLUGS

**⚠ CAUTION**

Electrical Shock can cause injury.

Do not touch wires while engine is running.

### Spark Plug Component and Details




| | | | |
|---|---|---|---|
| **A** | Wire Gauge | **B** | Spark Plug |
| **C** | Ground Electrode | **D** | Gap |

NOTE: Do not clean spark plug in a machine using abrasive grit. Some grit could remain in spark plug and enter engine causing extensive wear and damage.

Engine misfire or starting problems are often caused by a spark plug that has improper gap or is in poor condition.

Engine is equipped with following spark plugs:

| | |
|---|---|
| Gap | 0.76 mm (0.030 in.) |
| Thread Size | 14 mm |
| Reach | 19.1 mm (3/4 in.) |
| Hex Size | 15.9 mm (5/8 in.) |

Refer to Maintenance for Repairs/Service Parts.

### Service

Clean out spark plug recess. Remove plug and replace.

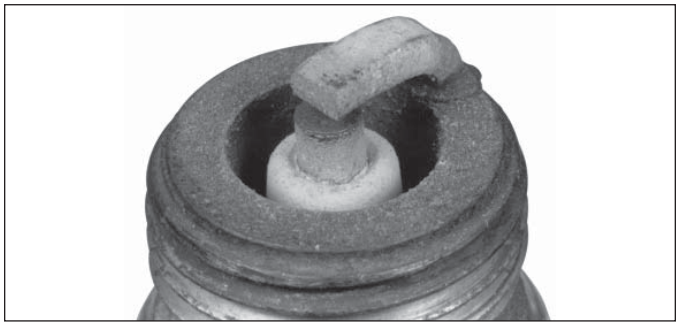
1. Check gap using wire feeler gauge. Adjust gap to 0.76 mm (0.030 in.).
2. Install plug into cylinder head.
3. Torque plug to 27 N·m (20 ft. lb.).

### Inspection

Inspect each spark plug as it is removed from cylinder head. Deposits on tip are an indication of general condition of piston rings, valves, and carburetor.

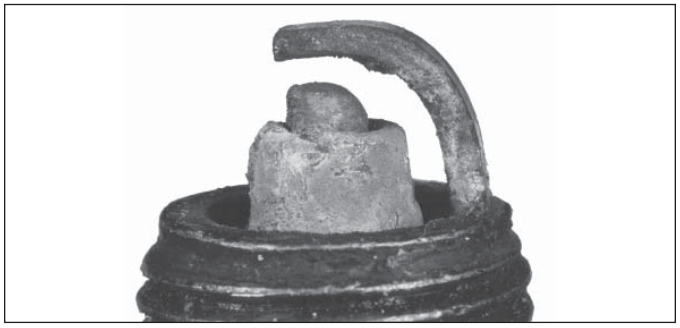
Normal and fouled plugs are shown in following photos:

**Normal**



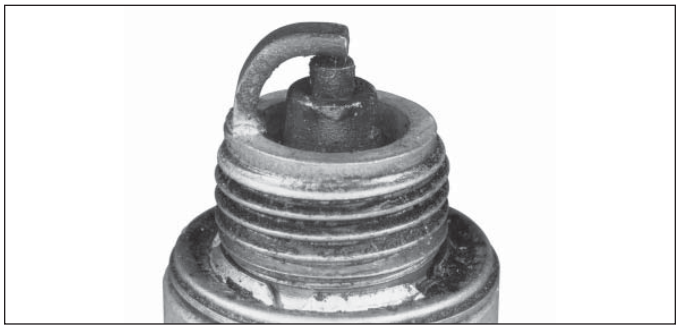
Plug taken from an engine operating under normal conditions will have light tan or gray colored deposits. If center electrode is not worn, plug can be set to proper gap and reused.

**Worn**



On a worn plug, center electrode will be rounded and gap will be greater than specified gap. Replace a worn spark plug immediately.

**Wet Fouled**



A wet plug is caused by excess fuel or oil in combustion chamber. Excess fuel could be caused by a restricted air cleaner, a carburetor problem, or operating engine with too much choke. Oil in combustion chamber is usually caused by a restricted air cleaner, a breather problem, worn piston rings, or valve guides.

**Carbon Fouled**

Soft, sooty, black deposits indicate incomplete combustion caused by a restricted air cleaner, over rich carburetion, weak ignition, or poor compression.

**Overheated**

Chalky, white deposits indicate very high combustion temperatures. This condition is usually accompanied by excessive gap erosion. Lean carburetor settings, an intake air leak, or incorrect spark timing are normal causes for high combustion temperatures.

## BATTERY

A 12 volt battery (not furnished) with a minimum current rating of 230 cold cranking amps/18 amp hours should be sufficient for cranking most electric start engine models. Actual cold cranking requirement depends on engine size, application, and starting temperatures. Cranking requirements increase as temperatures decrease and battery capacity shrinks. Refer to equipment's operating instructions for specific battery requirements.

If battery charge is insufficient to turn over engine, recharge battery.

### Battery Maintenance

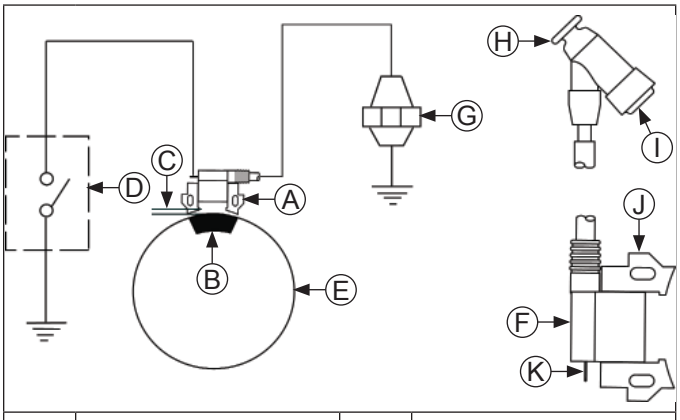
Regular maintenance is necessary to prolong battery life.

### Battery Test

To test battery, follow manufacturer's instructions.

## ELECTRONIC IGNITION SYSTEM

**Inductive Discharge Ignition System**




| | | | |
|---|---|---|---|
| **A** | Ignition Module | **B** | Magnet |
| **C** | Air Gap 0.252 mm (0.010 in.) | **D** | Kill Switch/Off Position of Key Switch |
| **E** | Flywheel | **F** | Ignition Module (Enlarged View) |
| **G** | Spark Plug | **H** | Spark Plug Boot |
| **I** | Spark Plug Terminal | **J** | Lamination |
| **K** | Kill Terminal | | |

These engines are equipped with a dependable magneto breakerless ignition. In such a system, electrical energy is generated by cutting of magnetic flux lines generated from ignition magnet on engine flywheel via prescribed air gap as it passes ignition module. This energy is transferred through ignition module laminations and is then converted in module electronics and stored in module primary coil, as a current. Stored energy is transferred at correct moment by triggering a semiconductor switch inside module. Electrical break by switch initiates energy transfer by causing collapse of magnetic field at coil primary. This includes a voltage at coil primary that is amplified via transformer action at coil secondary. Amplitude of voltage at coil secondary is sufficient to jump gap at spark plug, igniting fuel air mixture in gap and initiating combustion. Note that by design, these modules only will provide proper function if mounted in correct orientation.

This ignition system is designed to be trouble free for life of engine. Other than periodically checking/replacing spark plugs, no maintenance or timing adjustments are necessary or possible. Mechanical systems do occasionally fail or break down. Refer to Troubleshooting to determine root of a reported problem.

Reported ignition problems are most often due to poor connections. Before beginning test procedure, check all external wiring. Be certain all ignition-related wires are connected, including spark plug leads. Be certain all terminal connections fit snugly. Make sure ignition switch is in run position.

### Electronic Ignition Systems and Oil Sentry™ Tests

1. Disconnect cap from spark plug and attach it to terminal end of spark tester. Attach tester spring clip to a good ground, not to spark plug. Turn ignition/key switch ON and crank engine while observing firing tip of tester.

| Condition | Conclusion |
|---|---|
| Tester is firing. | Ignition system is good. Install a new spark plug and try to start engine. If it still will not start, check other possible causes (fuel, compression, etc.). |
| Tester doesn't fire. | Go to step 2. |

2. On electric start engines, remove starter cover panel. Locate black/white kill lead coming from ignition module inside blower housing. Disconnect bullet connector where kill lead plugs into harness. Repeat spark test (step 1).

| Condition | Conclusion |
|---|---|
| Spark is now present. | Check for a shorted lead in kill circuit or a faulty switch (step 7). |
| Still no spark. | Go to step 3. |

3. Disconnect bullet connector where Oil Sentry™ control module joins lead from Oil Sentry™ float switch (yellow leads). Repeat spark test again.

| Condition | Conclusion |
|---|---|
| Spark is now present. | Control module or float switch is faulty. Test control module (step 4) and float switch (step 5). If there is still no spark, test ignition module (step 6). |

4. Set an ohmmeter to Rx1 scale and zero meter. Connect black ohmmeter lead to yellow Oil Sentry™ control module lead and touch red ohmmeter lead to black wire.

| Condition | Conclusion |
|---|---|
| Continuity should be indicated. | Replace Oil Sentry™ control module for any other results. |

5. Set an ohmmeter to Rx1 scale and zero meter. Connect one ohmmeter lead to Oil Sentry™ float switch lead (yellow with green sleeve) and touch other lead to a bare spot on crankcase (ground). Drain oil from crankcase and repeat test.

   With oil at proper level, no continuity should have been indicated. After oil was drained, continuity should have been indicated.

| Condition | Conclusion |
|---|---|
| No continuity indicated. | Remove closure plate from engine and remove float switch for further testing (steps 5a and 5b). |

   a. If continuity was indicated with and without oil above, check if insulation has been scraped off float switch lead.

| Condition | Conclusion |
|---|---|
| Lead wire is bare. | Allowing it to short, repair with electrical tape or replace float switch. |

   b. With float switch removed, connect one ohmmeter lead to float switch lead terminal and connect other lead to mounting bracket. Test resistance with switch in normal position and inverted. Repeat test 2 or 3 times in each direction.

| Condition | Conclusion |
|---|---|
| Switch continuity should be as indicated. | If not, replace it. |

6. Set an ohmmeter to Rx1K or Rx10K scale and zero. Connect one ohmmeter lead to kill lead (black/white) terminal and connect other lead into spark plug cap.
   a. Remove cap from spark plug lead and test resistance of cap alone.
   b. If resistances are other than specified, remove blower housing and remove ignition module. With kill lead and spark plug cap removed, test resistance from small spade terminal to core of spark plug lead wire. If resistance is not in this range, replace module.

| Resistance Chart | |
|---|---|
| Ignition Module | 13.5-18.0 K ohms |
| Cap | 4-6 K ohms |
| Spade Terminal to Spark Plug Lead Wire | 9.5-12.9 K ohms |

7. Set an ohmmeter to Rx1 scale and zero meter. Test ignition/key switch as follows.
   a. Trace two black leads from on/off switch and separate them from any connections. Connect ohmmeter leads to switch leads, and check for continuity in both switch positions.

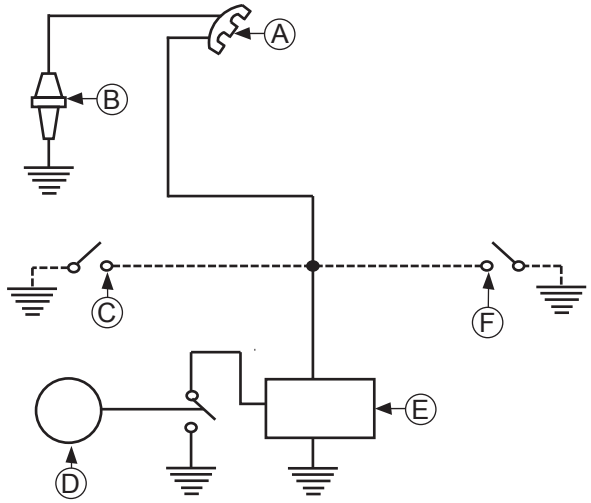
| Condition | Conclusion |
|---|---|
| Continuity should be indicated when and only when switch is in OFF position. | Replace switch for any other results. |

   b. On electric start engines, trace four leads (red, red/white, black, black/white) from key switch and separate them from any connections. Connect ohmmeter leads to black and black/white leads and check for continuity in all three switch positions. Then connect ohmmeter leads to red and red/white leads and test again in all three switch positions.

| Condition | Conclusion |
|---|---|
| Continuity should be indicated between black and black/white leads only when key switch is in OFF position. There should be continuity between red and red/white leads only in start position. | Replace switch for any other results. |

## BATTERY CHARGING SYSTEMS

### Wiring Diagram-Retractable Starter




| | | | |
|---|---|---|---|
| **A** | Ignition Module | **B** | Spark Plug |
| **C** | Optional Red Ignition Switch | **D** | Oil Float Switch |
| **E** | Oil Control Module | **F** | Optional Micro Shut Down Switch |

NOTE: Observe following guidelines to avoid damage to electrical system and components:

- Make sure battery polarity is correct. A negative (-) ground system is used.
- Make sure all ground connections are secure and in good condition.
- Disconnect both battery cables before doing electrical welding on equipment powered by engine. Also, disconnect other electrical accessories in common ground with engine.
- Prevent stator (AC) leads from touching or shorting while engine is running. This could damage stator.

Most engines are equipped with a 3,4,10, or 18 amp regulated battery charging system.

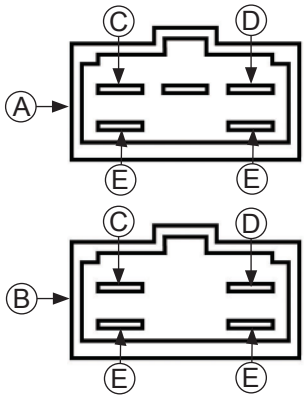
### 3/4/10/18 Amp Regulated Charging System

**Stator**

Stator is mounted on crankcase behind flywheel. Should stator have to be replaced, follow procedures in Disassembly.

**Rectifier-Regulator**

**Rectifier-Regulator Receptacle**




| | | | |
|---|---|---|---|
| **A** | 10 Amp | **B** | 18 Amp |
| **C** | B+ Charge Lead | **D** | Ground Lead |
| **E** | Stator Leads | | |

NOTE: When installing rectifier-regulator, push wiring harness plug into regulator receptacle until it locks into place.

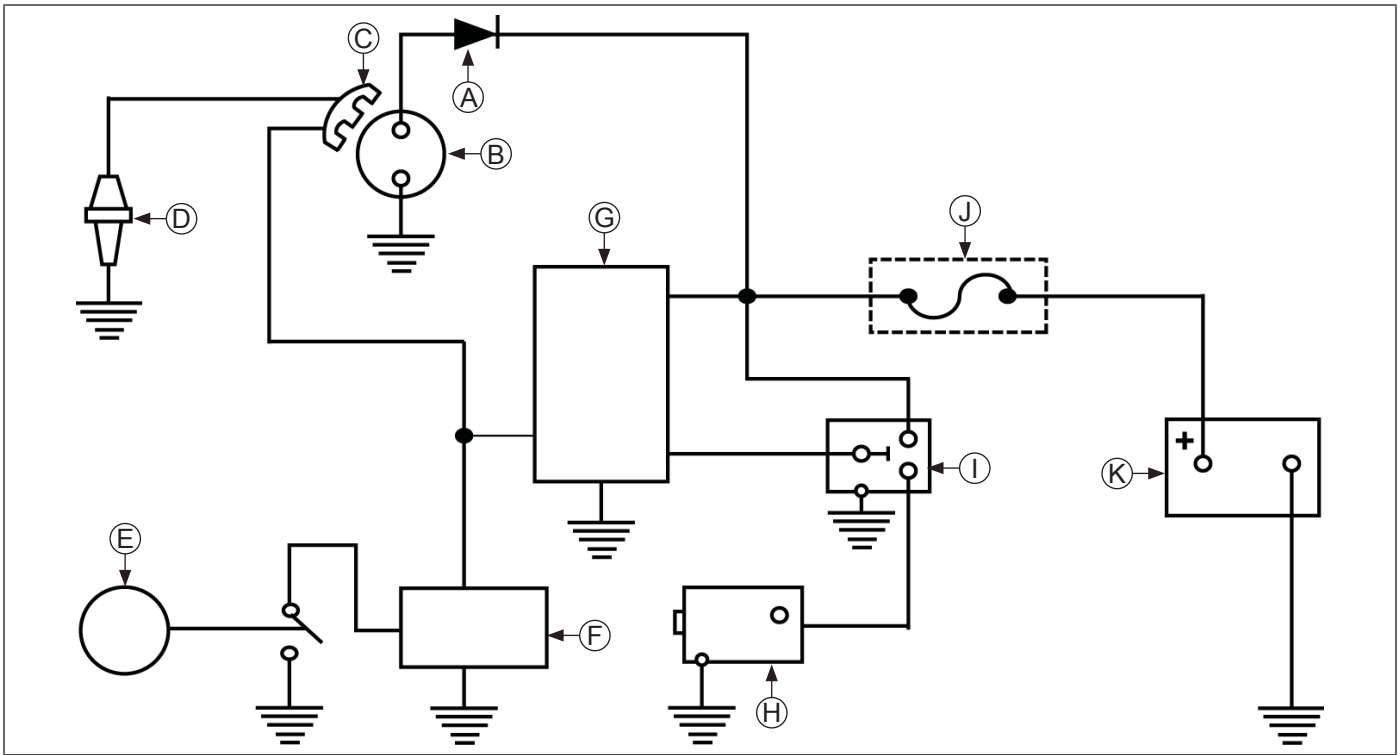
Rectifier-regulator is connected to engine with a matching wiring harness containing a plug-in connector. Grounded through wiring harness, rectifier-regulator is secured to equipment in a suitable location with two mounting screws. To replace it, disconnect plug, and remove two mounting screws.

Rectifier-regulator converts AC voltage coming from stator to DC voltage, while also monitoring and controlling battery voltage. There are two different rectifier-regulators which are used; an 18 amp and a 10 amp assembly. Although externally similar, internal circuits differ and two should not be interchanged.

### Rectified Only (non-regulated) Systems

Some engines are equipped with a rectified only, non-regulated charging system, with output ranging from 3 amps to 4 amps. Rectifier is normally connected to engine with a matching wiring harness and secured inside control panel. Grounding is achieved through wiring harness. Rectifier converts AC voltage coming from stator to DC voltage only.

**Wiring Diagram-3/4 Amp Charging System, Rectified Only**




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **A** | Diode | **B** | Stator | **C** | Ignition Module | **D** | Spark Plug |
| **E** | Oil Float Switch | **F** | Oil Control Module | **G** | Key Switch | **H** | Starter Motor |
| **I** | Relay | **J** | Battery Fuse | **K** | 12 Volt Battery | | |

### 3/4/10/18 Amp Battery Charging Systems

NOTE: Zero ohmmeters on each scale to ensure accurate readings. Voltage tests should be made with engine running at 3600 RPM - no load. Battery must be fully charged. Check specific gravity of battery. If low, recharge or replace battery as necessary.

To test charging system for no charge to battery:

1. Separate bullet connector in white lead from rectifier-regulator. Connect an ammeter from female terminal to positive (+) terminal of battery. Connect a DC voltmeter from female terminal to negative (-) terminal of battery. Leave other rectifier-regulator leads connected in normal manner. Run engine at 3600 RPM and read voltage on voltmeter.

   If voltage is 14.0 volts or more, place a minimum load of 5 amps (turn on lights if 60 watts or more, or place a 2.5 ohm, 100 watt resistor across battery terminals) on battery to reduce voltage. Observe ammeter.

| Condition | Conclusion |
|---|---|
| Voltage is 14.0-15.0 volts and charge rate increases when load is applied. | Charging system is OK and battery was fully charged. |
| Voltage is less than 14.0 volts or charge rate does not increase when load is applied. | Test stator (steps 2 and 3). |

2. Separate bullet connectors in AC (white) leads. Connect an AC voltmeter across stator leads (female terminals). With engine running at 3600 RPM, measure AC output from stator.

| Condition | Conclusion |
|---|---|
| Voltage is 20.0 volts or more. | Stator is OK. Rectifier-regulator is faulty; replace. |
| Voltage is less than 20.0 volts. | Stator is probably faulty and should be replaced. Test stator further using an ohmmeter (step 3). |

3. With engine stopped, measure resistance from each stator lead to ground using an ohmmeter.

| Condition | Conclusion |
|---|---|
| Resistance is infinity ohms (no continuity). | Stator is OK (not shorted to ground). |
| Resistance (or continuity) is measured. | Stator leads are shorted to ground; replace. |

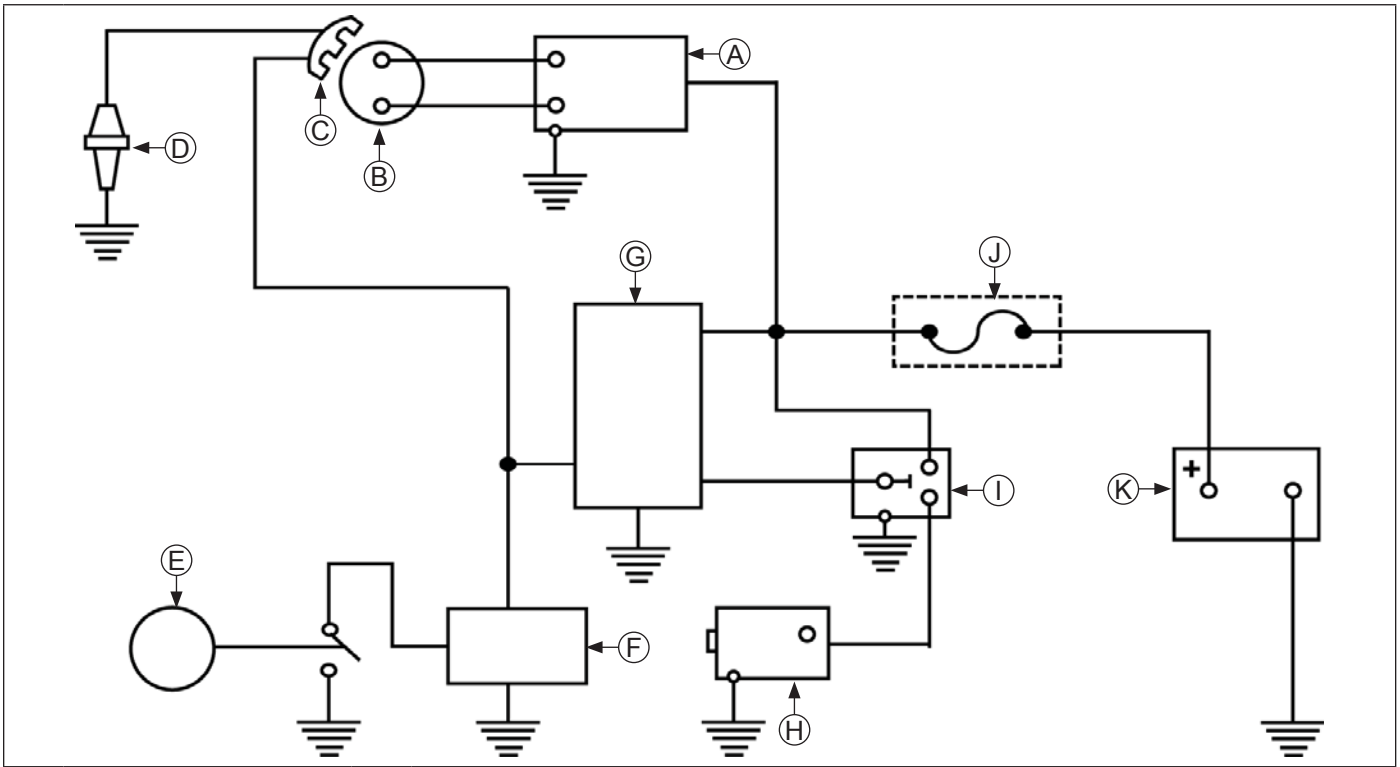
To test charging system for battery continuously charging at high rate:

1. Separate bullet connector in white lead from rectifier-regulator. Connect an ammeter from female terminal to positive (+) terminal of battery. Connect a DC voltmeter from female terminal to negative (-) terminal of battery. Leave other rectifier-regulator leads connected in normal manner. Run engine at 3600 RPM and read voltage on voltmeter.

   If voltage is 14.0 volts or more, place a minimum load of 5 amps (turn on lights if 60 watts or more, or place a 2.5 ohm, 100 watt resistor across battery terminals) on battery to reduce voltage. Observe ammeter.

| Condition | Conclusion |
|---|---|
| Voltage is 15.0 volts or less. | Charging system is OK. Battery is unable to hold a charge; service or replace. |
| Voltage is more than 15.0 volts. | Faulty rectifier-regulator; replace. |

**Wiring Diagram-10/18 Amp Charging System, with Rectifier-Regulator**




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **A** | Rectifier-Regulator | **B** | Stator | **C** | Ignition Module | **D** | Spark Plug |
| **E** | Oil Float Switch | **F** | Oil Control Module | **G** | Key Switch | **H** | Starter Motor |
| **I** | Relay | **J** | Battery Fuse | **K** | 12 Volt Battery | | |

NOTE: Do not crank engine continuously for more than 10 seconds. Allow a 60 second cool down period between starting attempts. Failure to follow these guidelines can burn out starter motor.

NOTE: If engine develops sufficient speed to disengage starter but does not keep running (a false start), engine rotation must be allowed to come to a complete stop before attempting to restart engine. If starter is engages while flywheel is rotating, starter pinion and flywheel ring gear may clash and damage starter.

NOTE: If starter does not crank engine, shut off starter immediately. Check condition of inline fuse and do not make further attempts to start engine until condition is corrected.

NOTE: Do not drop starter or strike starter housing. Doing so can damage starter.

Engines in this series use inertia drive electric starters or retractable starters. CH270 inertia drive electric starters are not serviceable.

**Troubleshooting-Starting Difficulties**

| Condition | Possible Cause | Conclusion |
|---|---|---|
| Starter does not energize. | Battery | Check specific gravity of battery. If low, recharge or replace battery as necessary. |
| | Wiring | Check fuse condition.<br>Clean corroded connections and tighten loose connections.<br>Replace wires in poor condition and with frayed or broken insulation. |
| | Starter Switch or Solenoid | Check switch or relay operation. If starter cranks normally, replace faulty components. |
| Starter energizes but turns slowly. | Battery | Check specific gravity of battery. If low, recharge or replace battery as necessary. |
| | Wiring | Check for corroded connections, poor ground connection. |
| | Transmission or Engine | Make sure clutch or transmission is disengaged or placed in neutral. This is especially important on equipment with hydrostatic drive. Transmission must be exactly in neutral to prevent resistance which could keep engine from starting.<br>Check for seized engine components such as bearings, connecting rod, and piston. |

**Electric Starting System Tests**

1. Test battery on unit.
   a. Connect a DC voltmeter across battery terminals and read battery voltage (key switch OFF).
   b. Turn key switch to start position and read battery voltage again. Turn switch OFF.

| Condition | Conclusion |
|---|---|
| Voltage less than 12 volts. | Charge battery. |
| Battery voltage should not fall below 9 volts during cranking. | If it does, battery may be faulty or there may be a short in starting circuit. Have battery load tested. If battery passes load test, check circuitry. |

2. Remove electric starter cover panel and check fuse inside plastic holder. Fuse outside holder is a spare.

| Condition | Conclusion |
|---|---|
| Fuse is blown. | Check for a wiring problem (bare wire, short circuit). Correct problem and replace fuse. Try to start engine. If it still won't start, go to step 3. |

3. Disconnect blue relay lead. Be sure transmission is in neutral and PTO is OFF. Connect one end of a jumper lead to positive terminal of battery. Connect other end to terminal of relay.

| Condition | Conclusion |
|---|---|
| Relay engages and starter begins to crank. | Key switch is faulty, or there is a wiring problem to/from key switch. Check wiring and test key switch circuits with an ohmmeter. |

4. Use a known, good, fully-charged battery and jumper cables to test starter motor. Be sure transmission is in neutral and PTO is OFF.

   Remove heavy lead from post terminal on starter. Connect one end of positive jumper cable to post terminal and connect other end to positive terminal of battery.

   Connect one end of negative jumper cable to negative terminal of battery. Touch other end of negative jumper cable to a bare surface on crankcase or to starter housing.

| Condition | Conclusion |
|---|---|
| Relay engages and starter begins to crank. | Key switch is faulty, or there is a wiring problem to/from key switch. Check wiring and test key switch circuits with an ohmmeter. |

5. Disconnect leads from starter relay and remove it from starter for testing.
   a. Set an ohmmeter on Rx1 scale and zero meter. Connect one ohmmeter lead to terminal of blue lead from relay. Connect other ohmmeter lead to relay mounting bracket.

| Condition | Conclusion |
|---|---|
| Meter reading less than 3.4 ohms, or an open circuit is indicated (infinity ohms). | Relay is faulty and must be replaced. |

   b. With ohmmeter still on Rx1 scale, connect leads to two large post terminals. Meter should indicate an open circuit (infinity ohms, no continuity).
   c. Leave ohmmeter leads connected to large terminals. Connect a jumper lead from positive terminal of battery to terminal of blue relay lead. Connect another jumper lead from negative terminal of battery to relay mounting bracket.

| Condition | Conclusion |
|---|---|
| When circuit is completed, applying 12 volts to energizing coil, an audible click should be heard as relay engages, and ohmmeter should then indicate continuity between large terminals. | Results are other than indicated, replace relay. |

**INERTIA DRIVE ELECTRIC STARTERS**

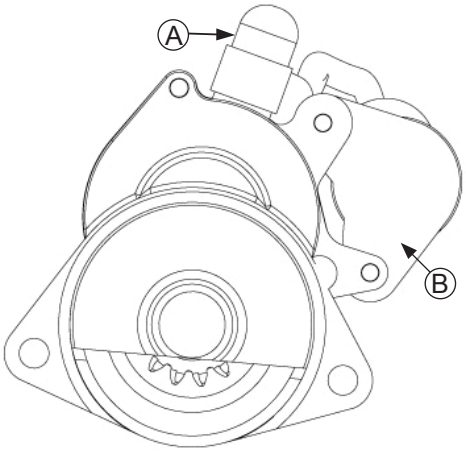
**⚠ WARNING**

Accidental Starts can cause severe injury or death.

Disconnect and ground spark plug lead(s) before servicing.

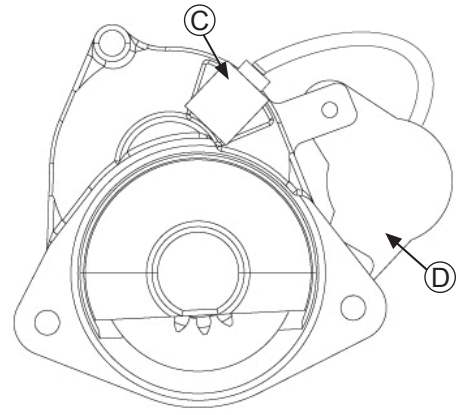
Before working on engine or equipment, disable engine as follows: 1) Disconnect spark plug lead(s). 2) Disconnect negative (–) battery cable from battery.

**Type I Starter CH395, CH440**

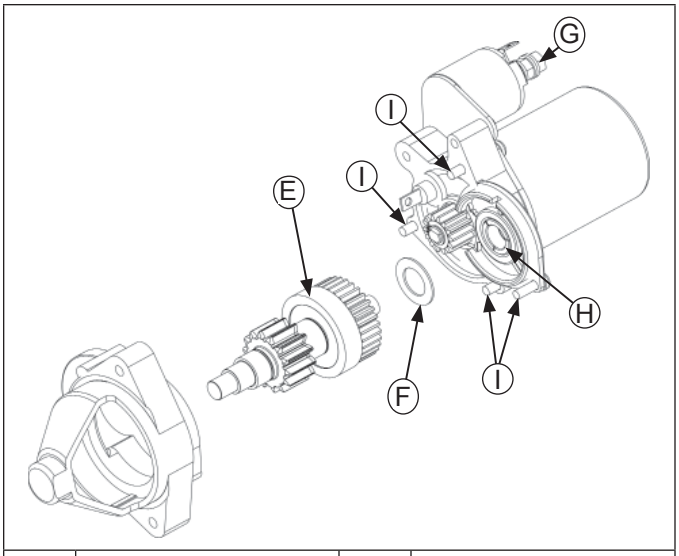



| | | | |
|---|---|---|---|
| **A** | Round Boot on Top of Starter | **B** | Relay (Solenoid) is Serviced |

**Type II Starter CH440**




| | | | |
|---|---|---|---|
| **C** | Square Boot at Front of Starter | **D** | Relay (Solenoid) is Serviced |




| | | | |
|---|---|---|---|
| **E** | Drive Assembly is Serviced | **F** | Shim |
| **G** | Relay (Solenoid) Nuts | **H** | Motor to Starter Drive Assembly |
| **I** | Four Screws | | |

### Relay (Solenoid) Replacement CH395, CH440

1. Disconnect all lead wires from relay (solenoid). Note location for reassembly.
2. Remove screws securing relay (solenoid), and remove relay (solenoid) from starter assembly.
3. Install new relay (solenoid) to starter assembly and secure with screws. Torque screws to 3.2 N·m (28 in. lb.).
4. Reconnect all lead wires to relay (solenoid). Torque nuts to 4.5 N·m (40 in. lb.).

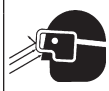
### Drive Replacement CH440 Type II Starter

NOTE: If access is available to remove screws (4) and separate drive end from motor gear end, starter removal is not necessary. If access is not available, remove starter assembly from engine.

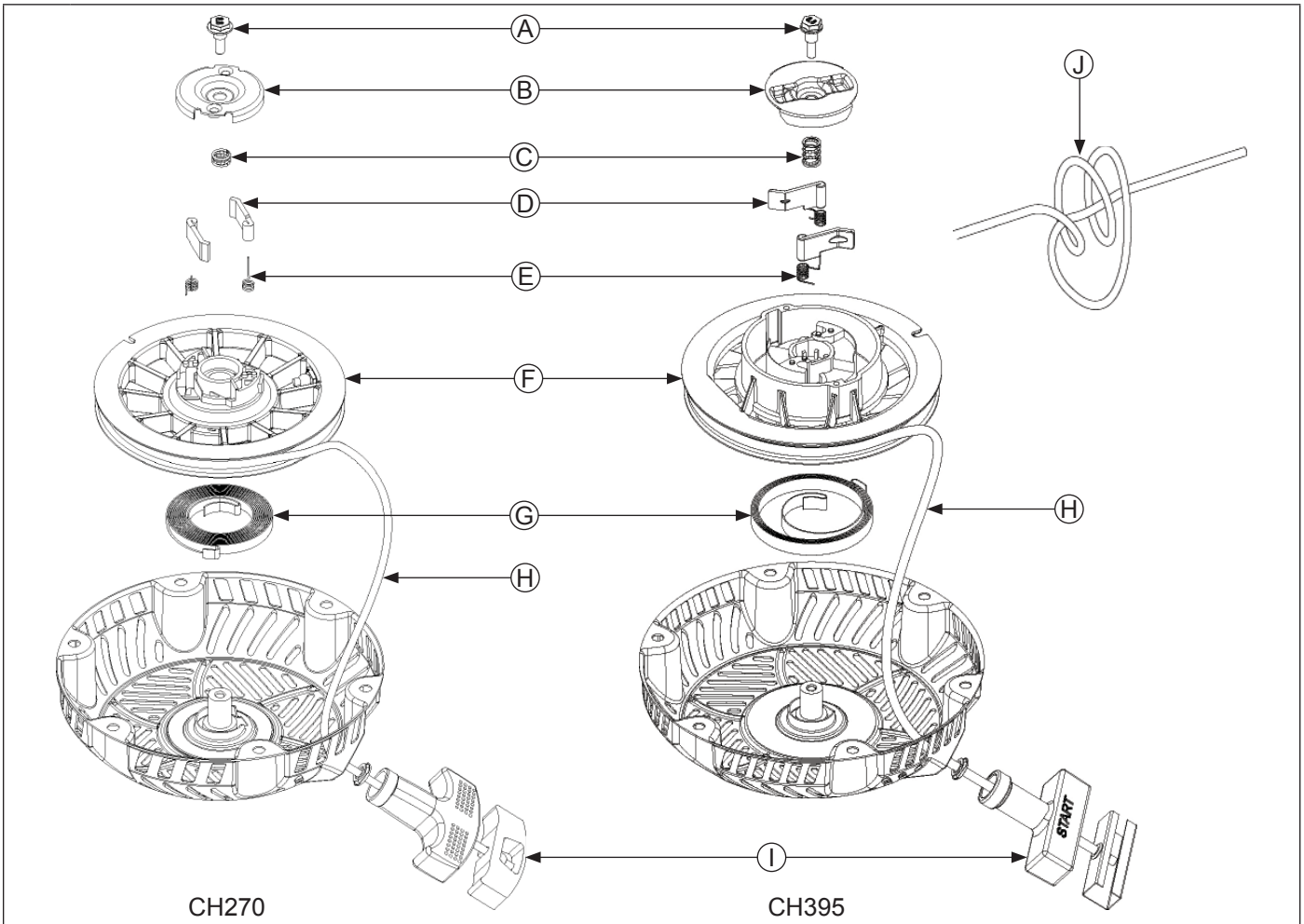
1. Disconnect all lead wires from starter. Note location of each for reassembly.
2. Move square boot to access and remove brush lead connector wire screw.
3. Remove 4 screws and separate starter.
4. Remove drive assembly and retain shim.
5. Lubricate motor to drive assembly gears with Kohler starter drive lubricant.
6. Install shim on motor side of new drive assembly.
7. Reassemble starter components in reverse order. Torque 4 screws to 5.8 N·m (51 in. lb.). Torque brush lead connector wire screw to 1.7 N·m (15 in. lb.).
8. If starter assembly was removed from engine, reinstall and torque mounting screws to 24 N·m (212 in. lb.).

# Starter System

## RETRACTABLE STARTERS

| | | |
|---|---|---|
|  | **⚠ WARNING**<br>Uncoiling Spring can cause severe injury.<br>Wear safety goggles or face protection when servicing retractable starter. | Retractable starters contain a powerful, recoil spring that is under tension. Always wear safety goggles when servicing retractable starters and carefully follow instructions in Retractable Starter for relieving spring tension. |

**Retractable Starter Components**




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **A** | Center Screw | **B** | Drive Plate | **C** | Friction Spring | **D** | Drive Pawl (Dogs) |
| **E** | Drive Pawl Springs | **F** | Pulley | **G** | Recoil Spring | **H** | Starter Rope |
| **I** | Starter Handle | **J** | Double Left-Hand Knot | | | | |

### Remove Starter

1. Remove screws securing starter to blower housing.
2. Remove starter assembly.

### Rope Replacement

NOTE: Do not allow pulley/spring to unwind. Enlist aid of a helper if necessary.

Rope can be replaced without complete starter disassembly.

1. Remove starter assembly from engine.
2. Pull rope out approximately 12 in. and tie a temporary (slip) knot in it to keep it from retracting into starter.
3. Pull knot end out of handle, untie knot, and slide handle off.
4. Hold pulley firmly and untie slipknot. Allow pulley to rotate slowly as spring tension is released.
5. When all spring tension on starter pulley is released, remove rope from pulley.
6. Tie a double left-hand knot in one end of new rope.
7. Rotate pulley counterclockwise to pre-tension spring (approximately 4 full turns of pulley).
8. Continue rotating pulley counterclockwise until rope hole in pulley is aligned with rope guide bushing of starter housing.
9. Insert unknotted end of new rope through rope hole in starter pulley and rope guide bushing of housing.
10. Tie a slipknot approximately 12 in. from free end of rope. Hold pulley firmly and allow it to rotate slowly until slipknot reaches guide bushing of housing.
11. Insert starter rope through starter handle and tie a double, left-hand knot at end of starter rope. Insert knot into hole in handle.
12. Untie slip knot and pull on starter handle until starter rope is fully extended. Slowly retract starter rope into starter assembly. If recoil spring is properly tensioned, starter rope will retract fully and starter handle will stop against starter housing.

### Pawls (dogs) Replacement

1. Install a clamp to hold pulley in starter housing and prevent it from rotating.
2. Unscrew center screw and lift off drive plate.
3. Note positions of pawls and pawl springs before removing. Remove parts from pulley.
4. Install pawl springs and pawls into pawl slots of pulley. All parts must by dry.
5. Position drive plate over pawls, aligning actuating slots in place with raised sections on each drive pawl. Torque center screw to 5-6 N·m (44-54 in. lb.).
6. Remove clamp and pull starter rope out part way to check operation of pawls.

### Install Starter

1. Install retractable starter onto blower housing leaving screws slightly loose.
2. Pull starter handle out until pawls engage in drive cup. Hold handle in this position and tighten screws securely.