

Product: KOHLER MV16,MV18,MV20 Twin Cylinder Engine Service Repair Workshop Manual

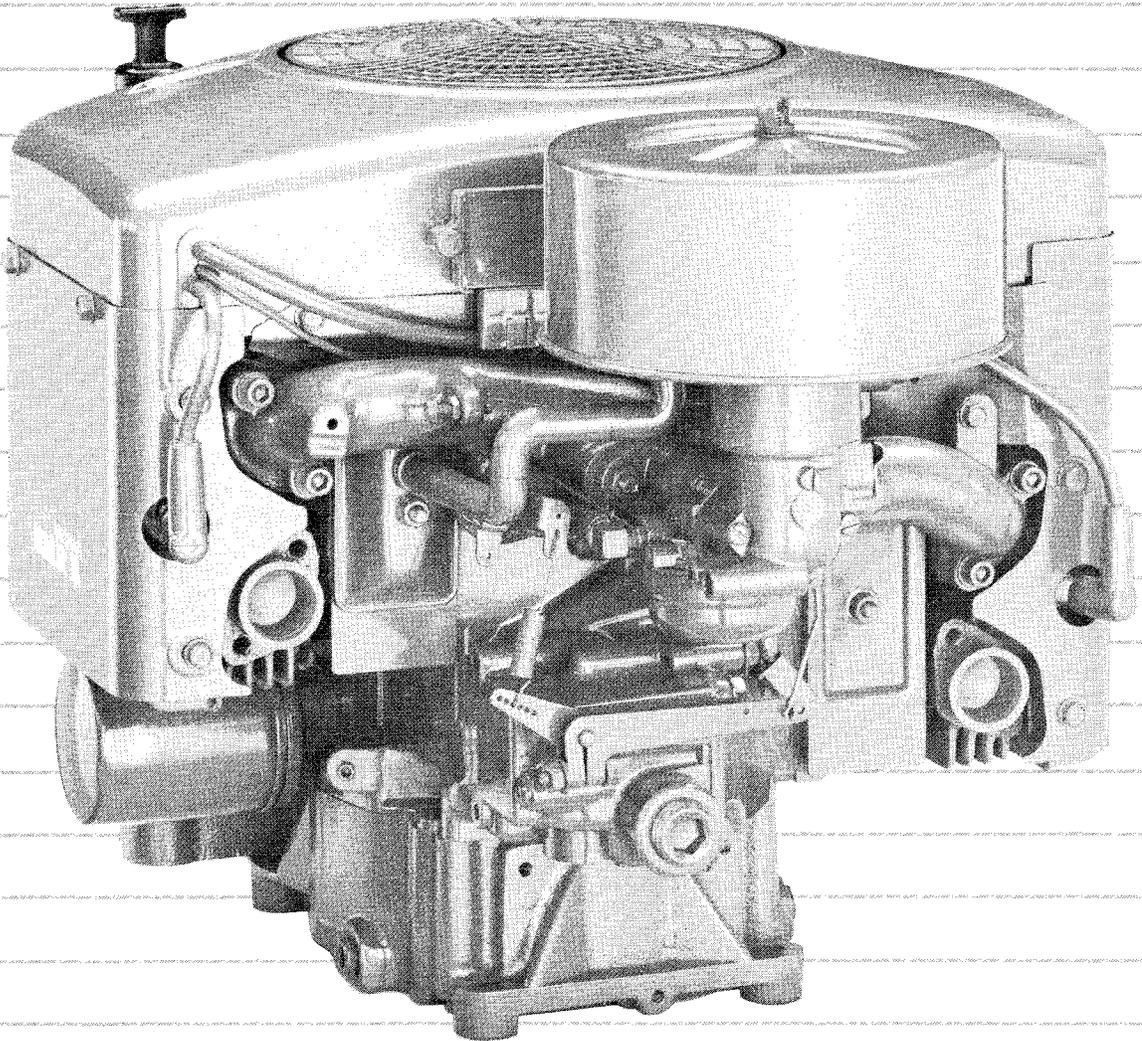
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# SERVICE MANUAL

# MAGNUM

MODELS MV16, MV18, MV20



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**KOHLER**  
engines

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# SECTION 1 GENERAL INFORMATION

## ENGINE IDENTIFICATION NUMBERS

When ordering parts, or in any communication involving an engine, always give the Model, Specification, and Serial numbers of the engine.

The engine identification numbers appear on a decal (or decals) affixed to the engine shrouding. Refer to Figure 1-1. The significance of these numbers is shown below:

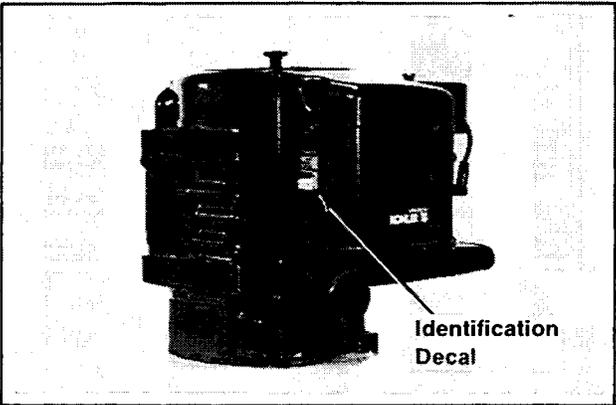


Figure 1-1. Location Of Engine Identification Decal.

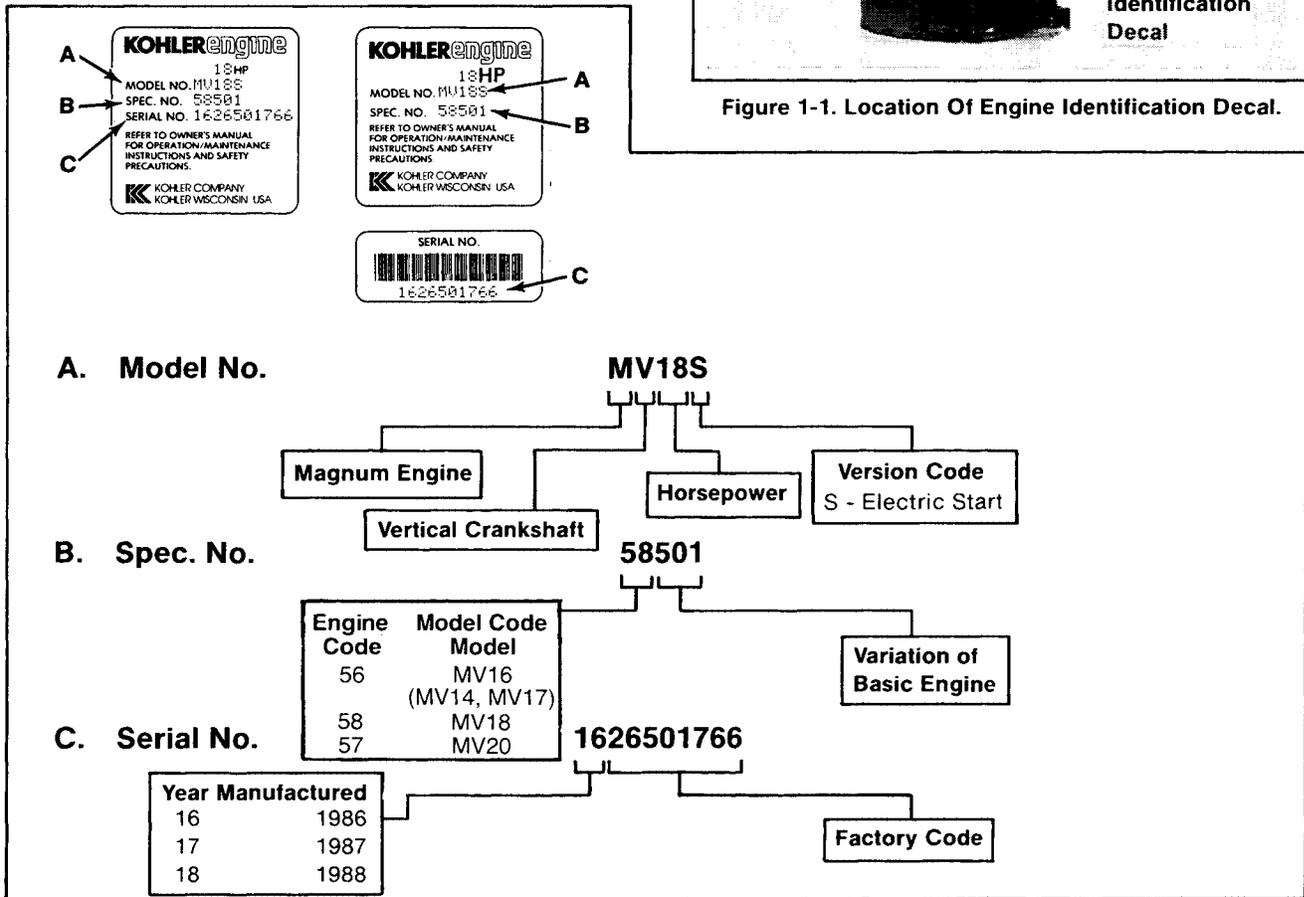


Figure 1-2. Engine Identification Decals.

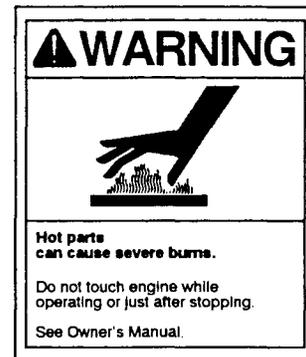
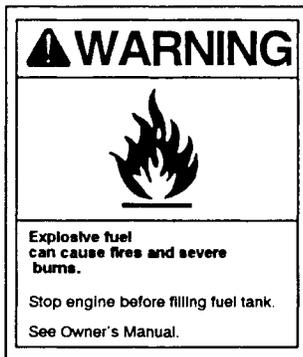
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## FOR YOUR SAFETY

### WARNING: For Your Safety!



*This symbol points out important safety Warnings and Cautions throughout this manual. These Warnings and Cautions should be followed at all times. Failure to follow Warnings and Cautions could result in injury to yourself and others nearby.*



### WARNING: Explosive Fuel!



*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. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.*

### WARNING: Rotating Parts!



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

### WARNING: Hot Parts!



*Engine components can get extremely hot from operation. To prevent severe burns, do not touch these areas while the engine is running—or immediately after it is turned off. Never operate the engine with heat shields or guards removed.*

**WARNING: Accidental Starts!**



*Before servicing the engine or equipment, always disconnect the spark plug lead to prevent the engine from starting accidentally. Ground the lead to prevent sparks that could cause fires. Make sure the equipment is in neutral.*

**WARNING: Dangerous Acid, Explosive Gases!**



*Batteries contain sulfuric acid. To prevent acid burns, avoid contact with skin, eyes, and clothing. Batteries produce explosive hydrogen gas while being charged. To prevent a fire or explosion, charge batteries only in well ventilated areas. Keep sparks, open flames, and other sources of ignition away from the battery at all times. Keep batteries out of the reach of children. Remove all jewelry when servicing batteries.*

**WARNING: Flammable Solvents!**



*Carburetor cleaners and solvents are extremely flammable. Keep sparks, flames, and other sources of ignition away from the area. Follow the cleaner manufacturer's warnings and instructions on its proper and safe use. Never use gasoline as a cleaning agent.*

**CAUTION: Electrical Shock!**



*Never touch electrical wires or components while the engine is running. They can be sources of electrical shock.*

**WARNING: Spring Under Tension!**



*Retractable starters contain a powerful, flat wire recoil spring that is under tension. Do not remove the center screw from the starter until the spring tension is released. Removing the center screw before releasing spring tension, or improper starter disassembly, can cause the sudden and potentially dangerous release of the spring.*

**WARNING: Lethal Exhaust Gases!**



*Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled. Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area.*

*Before disconnecting the negative (-) ground cable, make sure all switches are OFF. If ON, a spark will occur at the ground cable terminal which could cause an explosion if hydrogen gas or gasoline vapors are present.*

*Always wear safety goggles when servicing retractable starters—full face protection is recommended.*

**WARNING: Overspeed Is Hazardous!**



*Do not tamper with the governor setting. Overspeed is hazardous and could cause personal injury.*

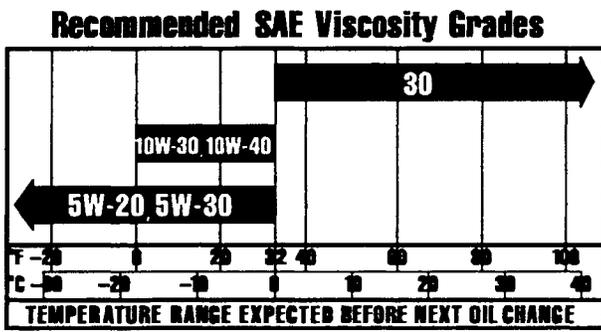
*To ensure personal safety and proper starter disassembly and reassembly, follow the procedures in this section carefully.*

## OIL RECOMMENDATIONS

Using the proper type and weight of oil in the engine crankcase and in the gear reduction unit is extremely important, as is checking oil daily and changing oil regularly. Failure to use the correct oil or using dirty oil causes premature engine wear and failure.

### Oil Type

Use high-quality detergent oil of API (American Petroleum Institute) Service Class SF or SG. Select the viscosity based on the air temperature at the time of operation as shown in the table.



Straight 30-weight oil is preferred. SAE 10W-30 and 10W-40 are not recommended above 32°F (0°C). Using these oils substantially increases oil consumption and combustion chamber deposits.

**NOTE:** Using other than Service Class SF or SG oil or extending oil change intervals longer than recommended could cause engine damage which is not covered by the engine warranty.

A logo or symbol on oil containers identifies the API service class and SAE viscosity grade. Refer to Figure 1-3.



Figure 1-3. Oil Container Logo.

### Check Oil Level

Check oil level BEFORE EACH USE.

**CAUTION:** Do not operate the engine with the oil level below the "L" mark or over the "F" mark on dipstick. Refer to Figure 1-4.

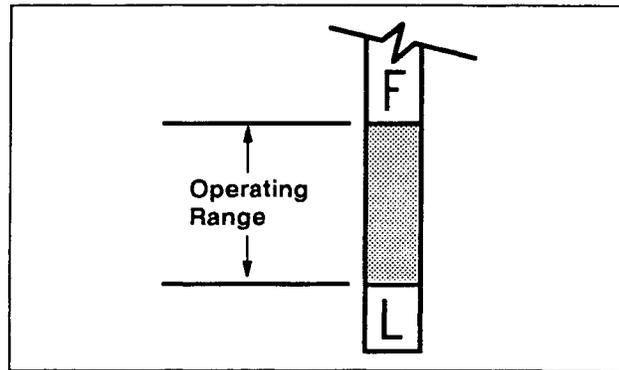


Figure 1-4. Oil Level Operating Range.

### Change Oil

**For a new engine,** change oil after the first 5 hours of operation. Thereafter, change the oil as specified in the following "Oil Change Intervals" table.

For an overhauled engine or those rebuilt with a new shortblock, use straight 30-weight Service Class SF or SG for the first 5 hours of operation. Change the oil after this initial run-in period. Refill with Service Class SF or SG as specified in the table.

### OIL CHANGE INTERVALS

Temperature	Oil Type	Engine Type	Interval
<b>ABOVE 32°F (0°C)</b>	SAE 30	With Filter	50 Hours*
		Without Filter	25 Hours
	Multiviscosity	With Filter	25 Hours
		Without Filter	25 Hours
<b>BELOW 32°F (0°C)</b>	Multiviscosity	With Filter	50 Hours
		Without Filter	25 Hours

\*25 hours for continuous and/or heavy duty operation.

### Oil Filter

Some engines are equipped with an oil filter. Replace the oil filter every other oil change, in accordance with the "Oil Change Intervals" table. Always use a genuine Kohler replacement oil filter.

Refer to the "Periodic Maintenance" section for detailed oil checking and changing procedures.

Do not use gasoline left over from the previous season, to minimize gum deposits in your fuel system and to insure easy starting.

Do not add oil to the gasoline.

Do not overfill the fuel tank. Leave room for the fuel to expand.

### FUEL RECOMMENDATIONS

**WARNING: Explosive Fuel!**



*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. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.*

### Fuel Type

For best results, use only clean, fresh, unleaded gasoline with a pump sticker octane rating of 87 or higher. In countries using the Research method, it should be 90 octane minimum.

Unleaded gasoline is recommended, as it leaves less combustion chamber deposits. Leaded gasoline may be used in areas where unleaded is not available and exhaust emissions are not regulated. Be aware however, that the cylinder head will require more frequent service.

### Gasoline/Alcohol blends

Gasohol (up to 10% ethyl alcohol, 90% unleaded gasoline by volume) is approved as a fuel for Kohler engines. Other gasoline/alcohol blends are not approved.

### Gasoline/Ether blends

Methyl Tertiary Butyl Ether (MTBE) and unleaded gasoline blends (up to a maximum of 15% MTBE by volume) are approved as a fuel for Kohler engines. Other gasoline/ether blends are not approved.

### General Recommendations

Purchase gasoline in small quantities and store in clean, approved containers. A container with a capacity of 2 gallons or less with a pouring spout is recommended. Such a container is easier to handle and helps eliminate spillage during refueling.

### OVERALL DIMENSIONS

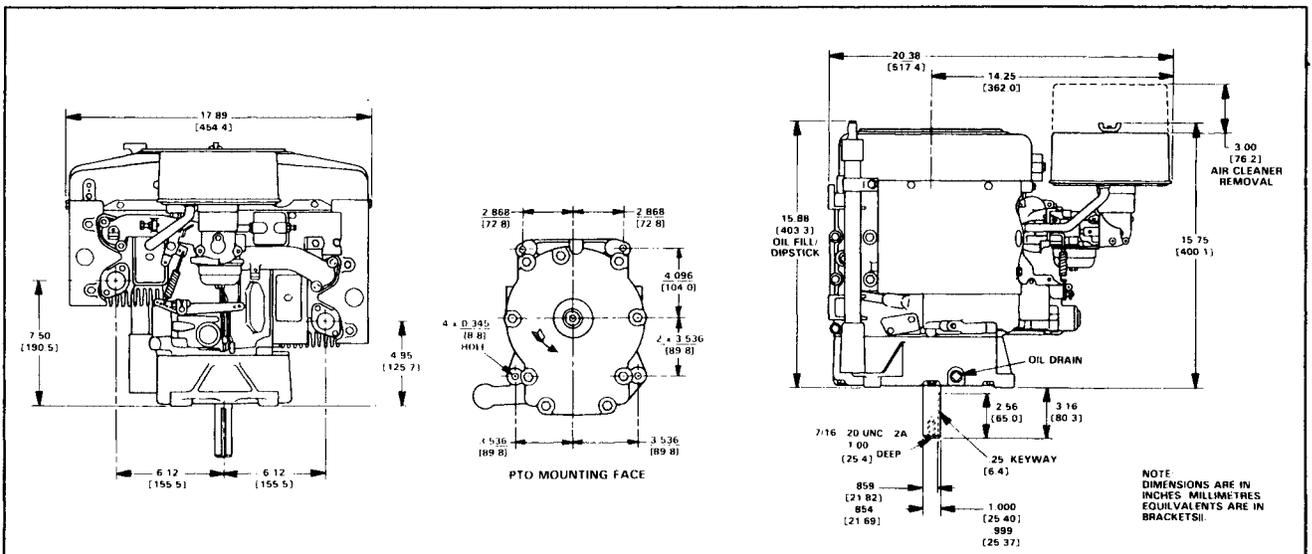


Figure 1-5. Overall Dimensions - Models MV16, MV18 and MV20.

## STANDARD TORQUE VALUES<sup>1</sup>

### Bolts, Screws, Nuts, and Fasteners Assembled Into Cast Iron or Steel



Size	Grade 2	Grade 5 <sup>3</sup>	Grade 8
#8-32	20 in. lb.	25 in. lb.	—
#10-24	32 in. lb.	40 in. lb.	—
#10-32	32 in. lb.	40 in. lb.	—
1/4-20	70 in. lb.	115 in. lb.	165 in. lb.
1/4-28	85 in. lb.	140 in. lb.	200 in. lb.
5/16-18	150 in. lb.	250 in. lb.	350 in. lb.
5/16-24	165 in. lb.	270 in. lb.	30 ft. lb.
3/8-16	260 in. lb.	35 ft. lb.	50 ft. lb.
3/8-24	300 in. lb.	40 ft. lb.	60 ft. lb.
7/16-14	35 ft. lb.	55 ft. lb.	80 ft. lb.
7/16-20	45 ft. lb.	75 ft. lb.	105 ft. lb.
1/2-13	50 ft. lb.	80 ft. lb.	115 ft. lb.
1/2-20	70 ft. lb.	105 ft. lb.	165 ft. lb.
9/16-12	75 ft. lb.	125 ft. lb.	175 ft. lb.
9/16-18	100 ft. lb.	165 ft. lb.	230 ft. lb.
5/8-11	110 ft. lb.	180 ft. lb.	260 ft. lb.
5/8-18	140 ft. lb.	230 ft. lb.	330 ft. lb.
3/4-10	150 ft. lb.	245 ft. lb.	350 ft. lb.
3/4-16	200 ft. lb.	325 ft. lb.	470 ft. lb.

### Bolts, Screws, Nuts, and Fasteners Assembled Into Aluminum



Size	Grade 2	Grade 5	Grade 8
#8-32	20 in. lb.	20 in. lb.	20 in. lb.
#10-24	32 in. lb.	32 in. lb.	32 in. lb.
1/4-20	70 in. lb.	70 in. lb.	70 in. lb.
5/16-18	150 in. lb.	150 in. lb.	150 in. lb.

### Oil Drain Plugs<sup>4</sup>

Size	Into Cast Iron Pans	Into Aluminum Pans
1/4"	150 in. lb.	100 in. lb.
3/8"	180 in. lb.	120 in. lb.
1/2"	20 ft. lb.	13 ft. lb.
3/4"	25 ft. lb.	16 ft. lb.
X-708-1 <sup>5</sup>	20/25 ft. lb.	20/25 ft. lb.

### Conversions

ft. lb. = in. lb. x 12  
in. lb. = ft. lb. ÷ 12  
kgm = ft. lb. x 0.1383  
Nm. = ft. lb. x 1.3558

## SPECIFICATIONS, TOLERANCES, AND SPECIAL TORQUE VALUES<sup>2</sup>

General	Model MV16	Model MV18	Model MV20
Horsepower (@ 3,600 rpm) .....	16	18	20
Displacement (cu. in.) .....	42.18	42.18	46.98
Bore .....	3.12	3.12	3.12
Stroke .....	2.75	2.75	3.06
Compression Ratio .....	5.8:1	6.0:1	6.0:1
Approx. Weight (lb.) .....	130	130	130
Approx. Oil Capacity* Engines Without Filter(U.S. Quarts) .....	1.75	1.75	1.75

\*For best results, fill to "F" mark on dipstick as opposed to adding a given quantity of oil. Always check level on dipstick before adding more oil. On engines equipped with oil filter, an additional 1/2 U.S. pint of oil is required when oil filter is replaced.

	Model MV16	Model MV18	Model MV20
<b>Angle of Operation - Maximum (At Full Oil Level; Intermittent Operation)</b>			
Carb. Side Up .....	30°	30°	30°
Carb. Side Down .....	30°	30°	30°
#1 Cylinder Up .....	25°	25°	25°
#1 Cylinder Down .....	25°	25°	25°
<b>Camshaft</b>			
End Play .....	.003/.013	.003/.013	.003/.013
Camshaft to Camshaft Bearing Running Clearance .....	.0010/.0025	.0010/.0025	.0010/.0025
<b>Carburetor</b>			
Preliminary Idle Fuel Screw Setting (Turns) .....	1/4	1/4	1/4*
Float Level .....	.690/.720	.690/.720	.690/.720
Throttle Plate/Choke Plate Retaining Screw Torque (in. lb.) .....	8/12	8/12	8/12
Main Fuel Jet Torque (in. lb.) .....	12/16	12/16	12/16
Bowl Retaining Scw Torque (in. lb.) .....	45/55	45/55	45/55
<b>Connecting Rod (Posi-Lock)</b>			
New Service Rod Nut Torque (in. lb.) <sup>4, 6</sup> .....	140	140	140
Used Rod Nut Torque (in. lb.) <sup>4, 6</sup> .....	100	100	100
Rod to Crankpin Running Clearance - New .....	.0012/.0024	.0012/.0024	.0012/.0024
Rod to Crankpin Max. Wear Limit .....	.0029	.0029	.0029
Rod to Piston Pin Running Clearance - New .....	.0006/.0011	.0006/.0011	.0006/.0011
Rod Side Play on Crankpin .....	.005/.016	.005/.016	.005/.016
<b>Crankcase/Cylinder Barrel</b>			
Intake and Exhaust Manifold Fastener Torque (in. lb.) .....	150	150	150
Oil Pan Fastener Torque (in. lb.) <sup>7</sup> .....	150	150	150
Cylinder Barrel Nut Torque (in. lb.) <sup>7</sup> .....	200	200	200
Crankcase Nut Torque (in. lb.) <sup>7</sup> .....	260	260	260
5/16" Crankcase Screw Torque (in. lb.) <sup>7</sup> .....	200	200	200
3/8" Crankcase Screw Torque (in. lb.) <sup>7</sup> .....	260	260	260
<b>Crankshaft</b>			
Crankshaft End Play .....	.002/.014	.002/.014	.002/.014
Main Bearing Surface Max. Wear Limit .....	1.7407	1.7407	1.7407
Sleeve Bearing Max. Out of Round .....	.0005	.0005	.0005
Sleeve Bearing Max. Taper .....	.001	.001	.001
New Sleeve Bearing Max. Running Clearance .....	.0049	.0049	.0049
Sleeve Bearing Running Clearance Max. Wear Limit .....	.0059	.0059	.0059
New Sleeve Bearing I.D. (installed) .....	1.7439/1.7461	1.7439/1.7461	1.7439/1.7461
Crankpin O.D. - New .....	1.3733/1.3738	1.3733/1.3738	1.4993/1.4998
Crankpin O.D. Max. Wear Limit .....	1.3728	1.3728	1.4988
Crankpin O.D. Max. Out of Round .....	.0005	.0005	.0005
Crankpin O.D. Max. Taper .....	.001	.001	.001
<b>Cylinder Bore</b>			
I.D. - New .....	3.1245/3.1255	3.1245/3.1255	3.1245/3.1255
I.D. Max. Wear Limit .....	3.128	3.128	3.128
I.D. Max. Out of Round .....	.002	.002	.002
I.D. Max. Taper .....	.0015	.0015	.0015

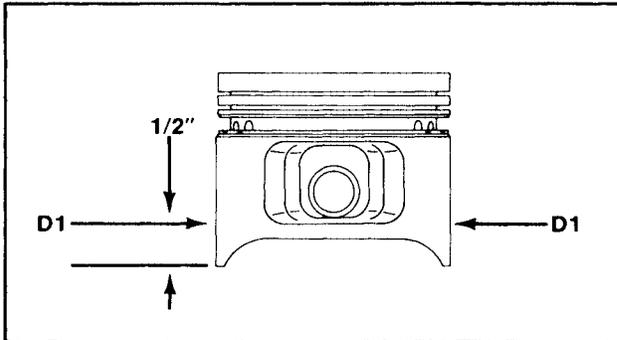
\*1 turn for High Idle on Walbro Adjustable Jet Carburetor.

	<b>Model MV16</b>	<b>Model MV18</b>	<b>Model MV20</b>
<b>Cylinder Head</b>			
Cap Screw Torque (ft. lb.) <sup>4, 7</sup> .....	15/20	15/20	15/20
Max. Out of Flatness .....	.003	.003	.003
<b>Fan/Flywheel</b>			
Fan Fastener Torque (in. lb.) .....	115	115	115
Flywheel Fastener Torque (ft. lb.) <sup>4</sup> .....	40	40	40
<b>Fuel Pump</b>			
Mounting Screw Torque (in. lb.) .....	40/45	40/45	40/45
<b>Ignition</b>			
Ignition Module to Magnet Air Gap .....	.008/.012	.008/.012	.008/.012
Spark Plug Type (Champion® or Equiv.) .....	RV15YC	RV15YC	RV15YC
Spark Plug Gap .....	0.025	0.025	0.025
Spark Plug Torque (ft. lb.) .....	10/15	10/15	10/15
<b>Oil Fill/Oil Filter<sup>10</sup></b>			
Engine Mtd. Filter Adapter Fastener Torque (in. lb.) .....	125	125	125
Remote Oil Filter Cover Fastener Torque (in. lb.) .....	125	125	125
Remote Oil Line Fitting Nut Torque (in. lb.) .....	65/80	65/80	65/80
Remote Oil Line Reducing Connector Torque (in. lb.) .....	65/80	65/80	65/80
Remote Oil Line Flare Nut Torque (in. lb.) .....	100/120	100/120	100/120
Remote Oil Filter Adapter Fitting Torque (in. lb.) .....	90/130	90/130	90/130
Oil Filter Installation Torque (in. lb.) .....	50/80	50/80	50/80
Oil Filter Bypass Cover Fastener Torque (in. lb.) .....	125	125	125
<b>Oil Pump</b>			
Pump Shaft to Crankcase Running Clearance .....	.0010/.0026	.0010/.0026	.0010/.0026
Pump Drive Gear End Play .....	.010/.029	.010/.029	.010/.029
<b>Piston and Piston Rings (Style "D" Pistons)</b>			
Thrust Face O.D. @ D1 - New <sup>9</sup> .....	3.1203/3.1210	3.1203/3.1210	3.1203/3.1210
Thrust Face O.D. @ D1 - Max. Wear Limit <sup>9</sup> .....	3.1181	3.1181	3.1181
Thrust Face to Bore Clearance @ D1 - New <sup>9</sup> .....	.0035/.0052	.0035/.0052	.0035/.0052
Piston Ring End Gap - New <sup>8</sup> .....	.010/.023	.010/.023	.010/.023
Piston Ring End Gap - Used (Max.) <sup>8</sup> .....	.032	.032	.032
Piston Ring Side Clearance - Max. .....	.006	.006	.006
Piston Pin O.D. - New .....	.6247/.6249	.6247/.6249	.7499/.7501
<b>Valves and Tappets</b>			
Intake Valve to Tappet Clearance - Cold .....	See Page 3.6		
Exhaust Valve to Tappet Clearance - Cold .....	See Page 3.6		
Intake Valve Minimum Lift - Zero Lash .....	.274	.274	.274
Exhaust Valve Minimum Lift - Zero Lash .....	.274	.274	.274
Intake Valve Minimum Stem O.D. .....	.3103	.3103	.3103
Exhaust Valve Minimum Stem O.D. .....	.3088	.3088	.3088
Nominal Valve Seat Angle (Intake & Exhaust) .....	45° & 30°	45° & 30°	45° & 30°
Valve Guide Reamer Size .....	.3125	.3125	.3125
Intake Valve Guide I.D. Max. Wear Limit .....	.005	.005	.005
Exhaust Valve Guide I.D. Max. Wear Limit .....	.007	.007	.007

**Notes:**

1. Use standard torque values when specific values are not given. Standard values have a tolerance of  $\pm 20\%$ .
2. All dimensions are in inches unless otherwise specified.
3. Also applies to self-tapping screws.
4. Lubricate with oil at assembly.
5. 3/8-16 thread with hex head nut and fiber gasket.

- 
6. Torque in increments to the value specified. Do not overtorque—loosen—and retorquer hex nuts on Posi-Lock connecting rods.
  7. Refer to the "Reassembly" section for instructions and tightening sequence.
  8. Top and center compression rings.
  9. Measurements @ D1 on Style "D" pistons are made perpendicular to piston pin in the position shown.



10. Refer to the "Lubrication System" section for additional information.

## SECTION 2 SPECIAL TOOLS

2

### SPECIAL SERVICE TOOL KIT NO. NU-3211-A

These quality tools are designed to help you perform specific disassembly, repair, and reassembly procedures. By using tools designed for the job, you can service engines easier, faster, and safer! In addition, you'll increase your service capabilities and customer satisfaction by decreasing engine down time.

The Special Service Tool Kit No. NU-3211-A can be ordered complete as shown (Refer to Figure 2-1), or the tools can be ordered individually. Contact your Kohler Distributor for price and availability.

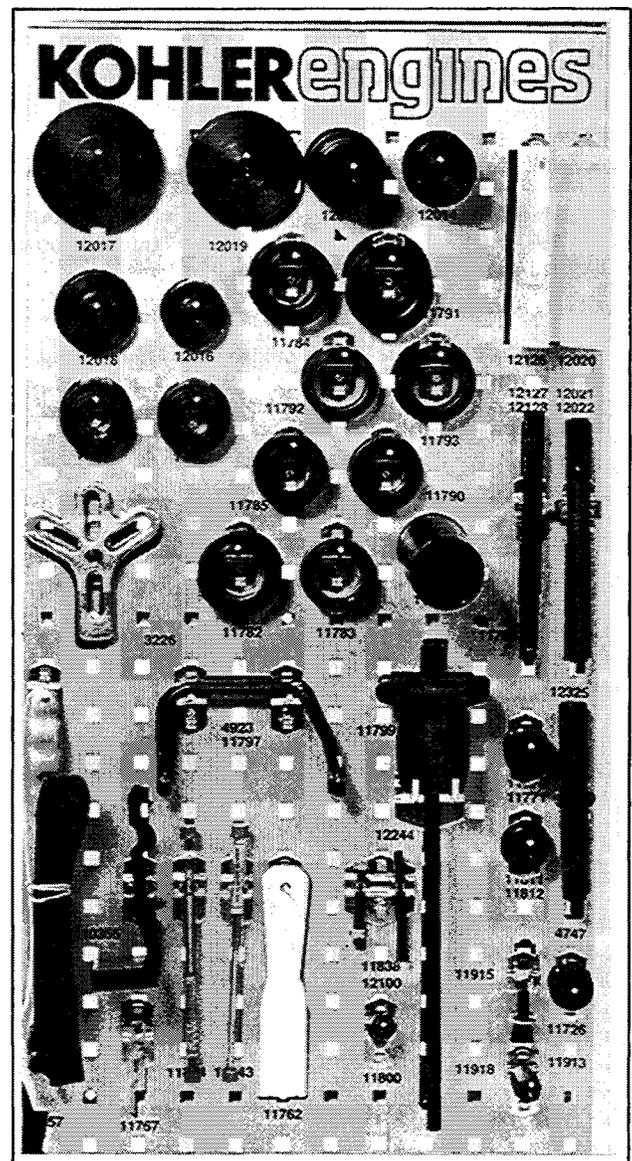
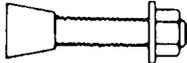
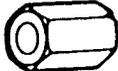
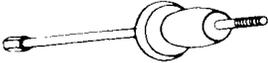
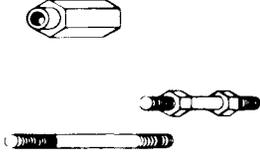
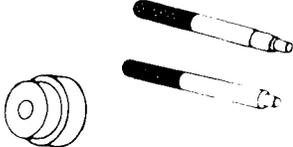
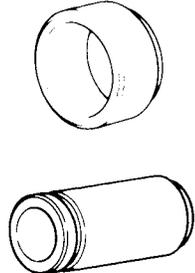


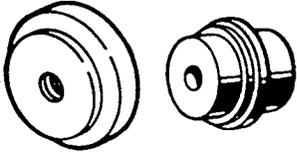
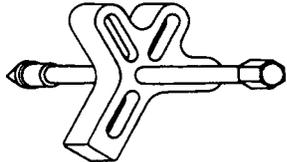
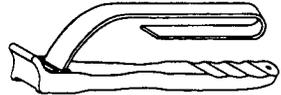
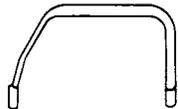
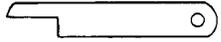
Figure 2-1. Special Service Tool Kit—No. NU-3211-A.

## VALVE SERVICE TOOLS

TOOL NO. & NAME	APPLICATION	ILLUSTRATION
<b>VALVE SEAT PULLERS</b> NU-11726 NU-11913	Removal of valve seats. Use NU-11918 adapter, NU-3222 slide hammer & NU-11915 forcing screw	
<b>FORCING SCREW</b> NU-11915	Used with valve seat pullers NU-11726 & NU-11913	
<b>ADAPTER</b> NU-11918	Used to connect valve seat pullers to slide hammer	
<b>VALVE SEAT INSTALLER</b> NU-11811 NU-11812	Used to install intake and exhaust seats. Use with NU-4747 handle	
<b>NU-3222 SLIDE HAMMER</b> NU-11799 Weight NU-12244 Slide Bolt	Provides pulling force for valve seat and guide removal. Use NU-4747 handle	
<b>NU-3268 VALVE GUIDE REMOVAL KIT</b> NU-11838 Stud 3 1/2" NU-12100 Stud 2 1/2" NU-11800 Adapter NU-0917 Nut NU-12008 Nut	Used to pull valve guides with NU-3222 slide hammer	
<b>NU-3224 VALVE GUIDE INSTALLER KIT</b> NU-12325 Driver NU-11763 Driver NU-11770 Gage NU-11771 Gage	Used to install valve guides to proper depth. Use NU-11763 driver with NU-11770 & NU-11771 depth gages	
<b>REAMERS (Valve Guide)</b> NU-11843 5/16" NU-11844 1/4"	To ream valve guides	

## SEAL AND BEARING INSTALLERS

<b>NU-3223 SEAL INSTALLER KIT</b> NU-11782 Seal Installer NU-11783 Seal Installer NU-11784 Seal Installer NU-11785 Seal Installer NU-11786 Seal Installer NU-11787 Seal Installer NU-11790 Seal Installer NU-11791 Seal Installer NU-11792 Seal Installer NU-11793 Seal Installer NU-11795 Handle	Used to install seals without damage and to proper depth. Use NU-11795 handle with installers	
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SEAL AND BEARING INSTALLERS		
TOOL NO. & NAME	APPLICATION	ILLUSTRATION
<b>NU-3242 SEAL PROTECTOR SLEEVE KIT</b> NU-12020 .75" NU-12021 1.00 NU-12022 1.25 NU-12126 1.12 NU-12127 1.50 NU-12128 1.44	Used on crankshaft when installing seals to prevent damage	
<b>NU-3241 BEARING INSTALLING KIT</b> NU-12014 Ins. (Crank Bushing) NU-12015 Ins. (Cam Bushing) NU-12016, NU-12017, NU-12018 & NU-12109 Brg. Installers	Used to install & remove engine bearings and bushings	
OTHER APPLICATIONS		
<b>NU-3226 FLYWHEEL PULLER KIT</b> NU-12485 Puller w/forcing screw NU-5108 Bolt - 1/4" w/washer (3) NU-12505 Bolt - 10-24 w/washer (2) NU-12504 Bolt - 3/8" w/washer (2) NU-12506 Storage Bag	Used to remove flywheels and bearing plates from engine	
<b>FLYWHEEL STRAP WRENCH</b> NU-10357	Used to hold flywheel for nut removal	
<b>OFFSET WRENCH</b> NU-11797 Wrench 1/2" NU-4923 Wrench 9/16"	Used to remove & install cylinder barrel retaining nuts	
<b>FEELER GAGE</b> NU-11767	Used to set oil pump drive gear backlash on twin cylinder engine	
<b>TIMING GAGE</b> NU-10355 Timing Gage	Used to hold balance gears in timed position when assembling engine	
<b>SCRAPER</b> NU-11762	Used to scrape machined surfaces without damage	
<b>HANDLE</b> NU-4747 Handle	Used with bearing installers, slide hammer, and valve seat installers	
<b>TOOL BOARD AND HOOK SET</b> NU-12033	Used to store and identify tools	SEE FRONT PAGE

## KIT NO. NU-3211-A TOOL USAGE CHART

PART NO. & NAME	MODEL ("K" SERIES)											MODELS ("M" SERIES)										
	K-91	K-181	K-181	K-241	K-301	K-321	K-341	KT-17	KT-19	K-532	K-582	M-8	M-10	M-12	M-14	M-16	M-18	M-20	M-16	M-18	All MV	
<b>VALVE TOOLS</b>																						
NU-11726 Valve Seat Puller		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-11913 Valve Seat Puller		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-11915 Forcing Screw		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-11918 Adapter		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-11811 Valve Seat Installer		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-11812 Valve Seat Installer	•																					
NU-3222 Slide Hammer		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-3268 Valve Guide Removal Kit		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-12325 Valve Guide Driver		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-11763 Valve Guide Driver (depth)								•	•								•	•	•	•	•	•
NU-11770 Valve Guide Depth Gage								•	*									•		•		•
NU-11771 Valve Guide Depth Gage									•										•		•	•
NU-11843 Valve Guide Reamer 3/16"		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-11844 Valve Guide Reamer 1/4"	•																					

\*KT19 Prior to Series II

### BEARING AND SEAL INSTALLERS

NU-12014 Installer — Crank Bushing											•	•										
NU-12015 Installer — Cam Bushing											•	•										
NU-12016 Installer — Bearing	•																					
NU-12017 Installer — Bearing (PTO)											•	•										
NU-12018 Installer — Bearing		•	•										•									
NU-12019 Installer — Bearing				•	•	•	•							•	•	•	•					
NU-11782 Installer — Seal (PTO)									•	•							•	•				
NU-11783 Installer — Seal (Flywheel)									•	•							•	•	•	•	•	•
NU-11784 Installer — Seal (PTO)				•	•	•	•						•	•	•	•						
NU-11785 Installer — Seal (PTO)		•	•										•									
NU-11786 Installer — Seal (Flywheel)	•																					
NU-11787 Installer — Seal (PTO)	•																					
NU-11790 Installer — Seal (Flywheel)		•	•										•									
NU-11791 Installer — Seal (PTO)											•	•										
NU-11792 Installer — Seal (Flywheel)				•	•	•	•						•	•	•	•						
NU-11793 Installer — Seal (Flywheel)											•	•										
NU-11795 Handle — Installer Seal	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				
NU-12020 Seal Sleeve																						
NU-12021 Seal Sleeve																						
NU-12022 Seal Sleeve																						
NU-12126 Seal Sleeve																						
NU-12127 Seal Sleeve																						
NU-12128 Seal Sleeve																						

### MISCELLANEOUS TOOLS

NU-10357 Flywheel Strap Wrench 1/2"	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
NU-11797 Offset Wrench 1/2"									•	•							•	•	•	•	•	•
NU-4923 Offset Wrench 9/16"									•	•												
NU-11767 Feeler Gauge-Crank (Oil Pump)											•	•										
NU-10355 Timing Tool (Balance Gear)					•	•	•	•							•	•	•	•				
NU-11762 Scraper	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-4747 Drive Handle	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
NU-3226 Flywheel Puller Kit	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

## ENGINE ANALYSIS KIT NO. 25 800 01

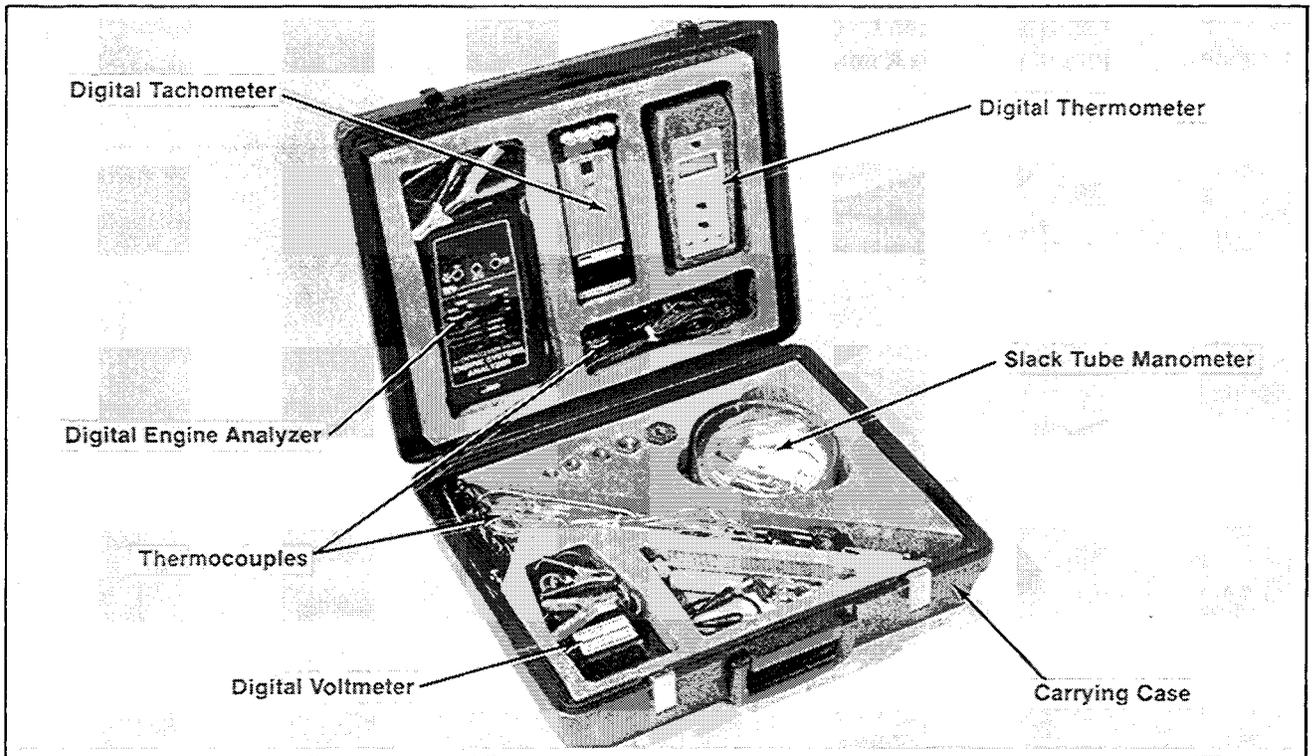


Figure 2-2. Engine Analysis Kit—No. 25 800 01.

The Kohler Engine Analysis Kit contains a selection of instruments which will enable you to measure critical items that relate to engine performance. You will find many uses for these instruments—from basic crankcase vacuum checks to sophisticated application tests.

The kit includes the following:

Qty.	Description	Part No.
1	Digital Voltmeter	25 800 02
1	Digital Tachometer	25 800 03
1	Digital Thermometer	24 800 04
1	Digital Engine Analyzer	25 800 05
1	Slack Tube Manometer	25 800 06
1	8 Ft. Lead With Plug	25 800 07
3	14 mm Spark Plug Thermocouple	25 800 08
2	Head Bolt Thermocouple	25 800 09
1	Oil Sump Thermocouple	25 800 10
1	1/4" x 1/8" Bushing	25 800 11
1	3/8" x 1/8" Bushing	25 800 12
1	1/2" x 1/8" Bushing	25 800 13
1	3/4" x 1/8" Bushing	25 800 14
1	Tube With Fittings	25 800 15
1	Carrying Case	25 800 16
3	Plain Thermocouple	25 800 17

The voltmeter, tachometer, thermometer, and engine analyzer feature state of the art electronic circuitry and digital readouts. Guidelines for using the instruments and testing are included.

Using the instruments in the kit you will be able to:

- Measure temperatures of -
  - spark plug base gasket/cylinder head bolt.
  - oil sump.
  - air into flywheel and carburetor.
- Measure engine speed (RPM).
- Measure crankcase vacuum and exhaust system back pressure.
- Measure voltage.
- Measure charging system current.
- Measure electric starter current (Amp) draw.

The Engine Analysis kit can be ordered complete as shown, or the instruments can be ordered individually. Contact your Kohler Distributor for price and availability.

## IGNITION SYSTEM TESTER

Magnum engines use a state of the art electronic ignition module. A simple tester can be used to determine if the ignition module is functioning properly.

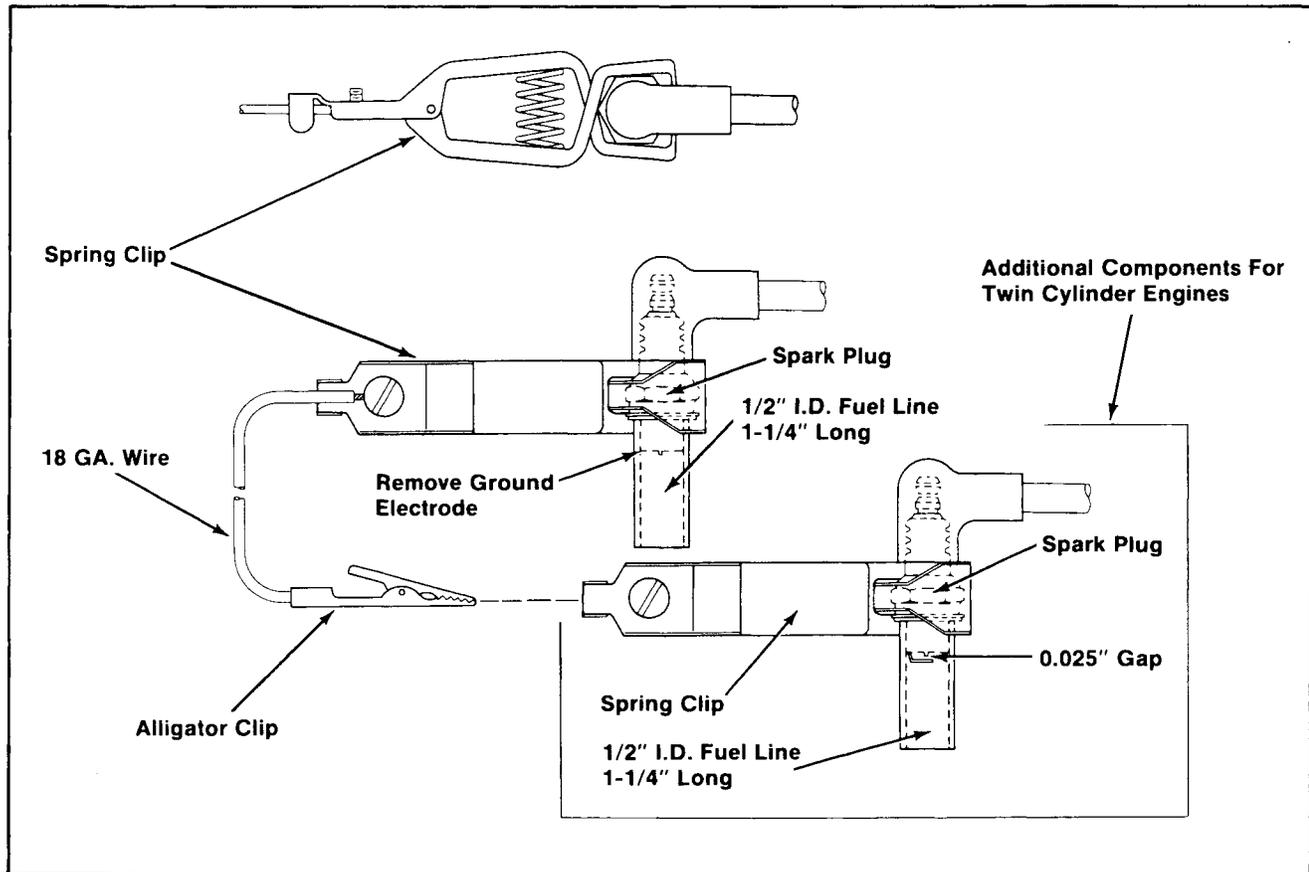


Figure 2-3. Electronic Ignition System Tester.

### For Twin Cylinder Engines

(Models M18, M20, MV16, MV18 and MV20)

1. Use the same tester made for testing single cylinder modules.
2. Obtain another new RJ-8 or RCJ-8 spark plug. Set the gap to **0.025"**.
3. Obtain another large spring clip. Attach the spring clip to the new spark plug. Connect the alligator clip from the single cylinder tester to the screw terminal end of the spring clip.
4. Install a 1-1/4" length of 1/2" I.D. fuel line onto the threads of the new spark plug.

### Using The Tester

Follow the instructions given in the "Electrical System And Components" section.

# SECTION 3 PERIODIC MAINTENANCE

## REQUIRED MAINTENANCE

These required maintenance procedures should be performed at the frequency stated in the table:

Required Maintenance	Frequency
Check Oil Level .....	Daily
Clean Grass Screen .....	Daily*
Check/Replace Fuel Filter .....	As Required
Change Oil and Filter .....	As Specified in "Oil Change Interval" Table
Clean Foam Precleaner .....	25 Hours*
Clean Cooling Fins and External Surfaces .....	50 Hours*
Clean Paper Air Cleaner Element .....	100 Hours*
Check Spark Plugs .....	100 Hours
Check Valve-To-Tappet Clearance .....	500 Hours
Clean Cylinder Heads and Combustion Chambers .....	500 Hours**
Service Starter Motor Drive .....	Annually or 500 Hours

\*Perform these maintenance procedures more frequently when engine is operated under extremely dusty and dirty conditions.

\*\*250 Hours when leaded gasoline is used.

### **WARNING: Accidental Starts!**



*Before servicing the engine or equipment, always remove the spark plug leads to prevent the engine from starting accidentally. Ground the leads to prevent sparks that could cause fires.*

### **CHECK OIL LEVEL**

The importance of checking and maintaining the proper oil level in crankcase cannot be overemphasized. Check oil **BEFORE EACH USE** as follows:

1. Make sure the engine is stopped, level, and is cool so the oil has had time to drain into the sump.
2. Clean the area around dipstick/oil fill tube before removing to keep dirt, grass clippings, etc., out of the engine.

- Remove the oil fill cap/dipstick and wipe oil off. Reinsert the dipstick and push it all the way down into tube. Remove the dipstick and check the level.

The oil level should be up to, but not over, the "F" mark on the dipstick. Refer to Figure 3-1.

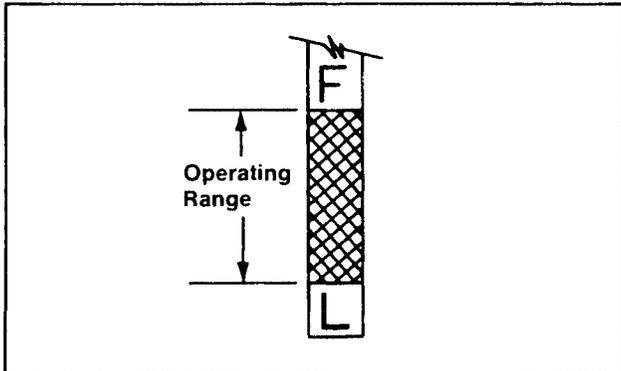


Figure 3-1. Oil Level Operating Range.

- Add the proper type of oil if the level is low. Always check the level with dipstick before adding more oil.

**CAUTION:** Never operate the engine with the oil level below "L" mark or over "F" mark on dipstick.

### Oil Sentry™



Some engines are equipped with optional Oil Sentry oil pressure monitor. Oil Sentry will either stop the engine or activate a "low oil" warning

light, if the oil pressure gets low. Actual Oil Sentry use will vary depending on the engine application.

**CAUTION:** Oil Sentry is not a substitute for checking oil level **BEFORE EACH USE**. Make sure the oil level is maintained up to the "F" mark on dipstick.

### CHANGE OIL

**For a new engine**, change the oil after the first 5 hours of operation. Thereafter, change oil as specified in the "Oil Change Intervals" table.

**For an overhauled engine or those rebuilt with a new Short Block**, use straight 30-weight Service Class SF or SG oil for the first 5 hours of operation. Change the oil after this initial run-in period. Thereafter, change the oil as specified in the "Oil Change Intervals" table.

Drain the oil while the engine is still warm from operation. The oil will flow more freely and carry away more impurities. Change oil as follows:

- Remove the oil drain plug and oil fill cap/dipstick. Refer to Figure 3-2. Tilt the engine slightly towards the drain hole to obtain better drainage.

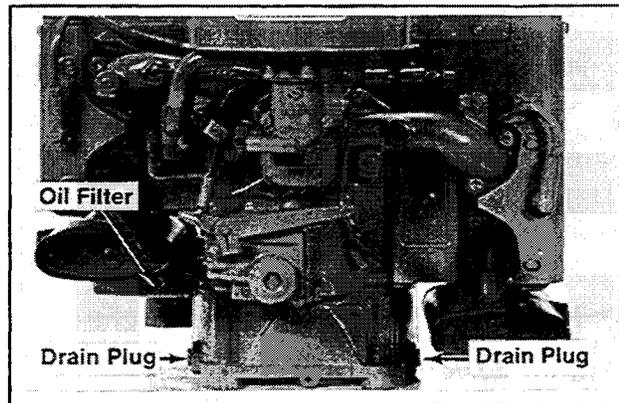


Figure 3-2. Oil Filter And Oil Drain Plug Locations.

### OIL CHANGE INTERVALS

Temperature	Oil Type	Engine Type	Interval
<b>ABOVE 32°F (0°C)</b>	SAE 30	With Filter	50 Hours*
		Without Filter	25 Hours
	Multiviscosity	With Filter	25 Hours
		Without Filter	25 Hours
<b>BELOW 32°F (0°C)</b>	Multiviscosity	With Filter	50 Hours
		Without Filter	25 Hours

\*25 hours for continuous and/or heavy duty operation.

2. Reinstall the drain plug. Make sure it is tightened securely.
3. Fill with new oil of the proper type to the "F" mark on the dipstick. Always check the level on dipstick before adding more oil. Make sure the engine is level when filling and checking oil.

## CHANGE OIL FILTER

Change the oil filter every other oil change, in accordance with the "Oil Change Intervals" table. Always use a genuine Kohler oil filter and change as follows:

1. Drain the crankcase oil, then remove old filter.
2. Before installing the replacement filter, apply a thin coating of oil on surface of the rubber seal.
3. Turn the filter clockwise until the rubber seal contacts the filter adapter, then tighten the filter an additional 1/2 turn.
4. Add an additional 1/2 pint of oil for the filter capacity.
5. Start the engine and check for and correct any oil leaks.

## SERVICE AIR CLEANER

These engines are equipped with a high-density paper air cleaner element. Some specifications are also equipped with an oiled foam precleaner which surrounds the paper element. Refer to Figure 3-3.

Also refer to the "Air Cleaner" section for illustrated disassembly and reassembly procedures.

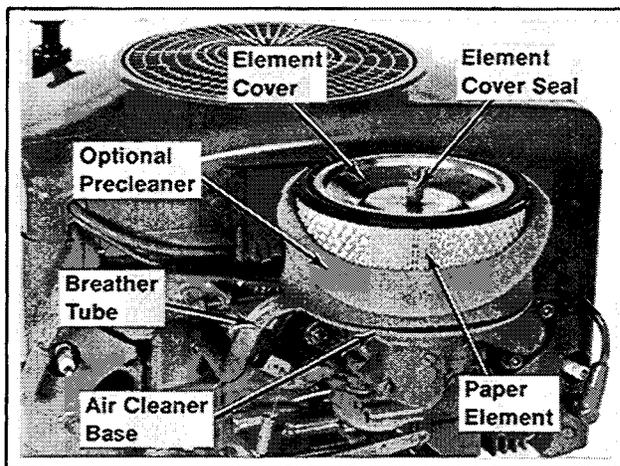


Figure 3-3. Air Cleaner Components.

## Precleaner

If so equipped, wash and reoil the precleaner every 25 operating hours (more often under extremely dusty, dirty conditions).

1. Remove the precleaner from paper element. Wash the precleaner in warm water with detergent.
2. Rinse the precleaner thoroughly until all traces of detergent are eliminated. Squeeze out excess water (do not wring). Allow the precleaner to air dry.
3. Saturate the precleaner in clean, fresh engine oil. Squeeze out excess oil.
4. Reinstall the precleaner over the paper element.

## Paper Element

Every 100 operating hours (more often under extremely dusty or dirty conditions) check the paper element. Replace the element as follows:

1. Remove the precleaner (if so equipped), element cover seal, element cover, and paper element.
2. Replace a dirty, bent or damaged element with a new genuine Kohler element. Handle new elements carefully; do not use if surfaces are bent or damaged.

**CAUTION:** Do not wash the paper element or use compressed air as this will damage element.

3. Reinstall the paper element, element cover, and element cover seal.
4. Install the precleaner (cleaned and oiled) over paper element.
5. Install the air cleaner cover and wing nut. Tighten the wing nut 1/2 to 1 full turn after it contacts the cover—do not overtighten.

## Inspect Air Cleaner Components

Whenever the air cleaner cover is removed, or the element or precleaner are serviced, check the following components:

- **Air Cleaner Base** - Make sure it seals tightly against intake elbow, and is not bent or damaged.

- **Element Cover and Element Cover Seal** - Make sure element cover is not bent or damaged. Make sure element cover seal is in place to ensure the element is sealed tightly between the element cover and air cleaner base.

- **Breather Tube** - Make sure it is sealed tightly in air cleaner base and breather cover.

**CAUTION:** Damaged, worn, or loose air cleaner components could allow unfiltered air into the engine causing premature wear and failure. Replace all damaged or worn components.

### CLEAN AIR INTAKE/COOLING AREAS

To ensure proper cooling, make sure the grass screen, cooling fins, and other external surfaces of engine are kept clean at all times. Refer to Figure 3-4.

Every 50 operating hours (more often under extremely dusty, dirty conditions), remove the blower housing and other cooling shrouds. Clean the cooling fins and external surfaces as necessary. Make sure the cooling shrouds are reinstalled.

Refer to the "Disassembly" and "Reassembly" sections for cooling shroud removal and installation procedures.

**CAUTION:** Operating the engine with a blocked grass screen, dirty or plugged cooling fins, and/or cooling shrouds removed will cause engine damage due to overheating.

### CHECK SPARK PLUGS

Every 100 operating hours, remove the spark plugs, check condition and reset gaps, or replace with new plugs as necessary. Refer to Figure 3-5.

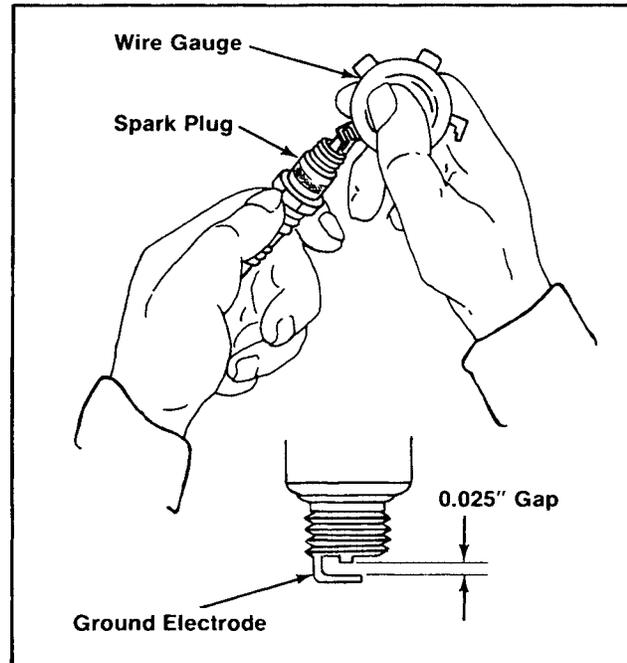


Figure 3-5. Servicing Spark Plugs.

1. Before removing spark plugs, clean the area around the base of plugs to keep dirt and debris out of the engine.

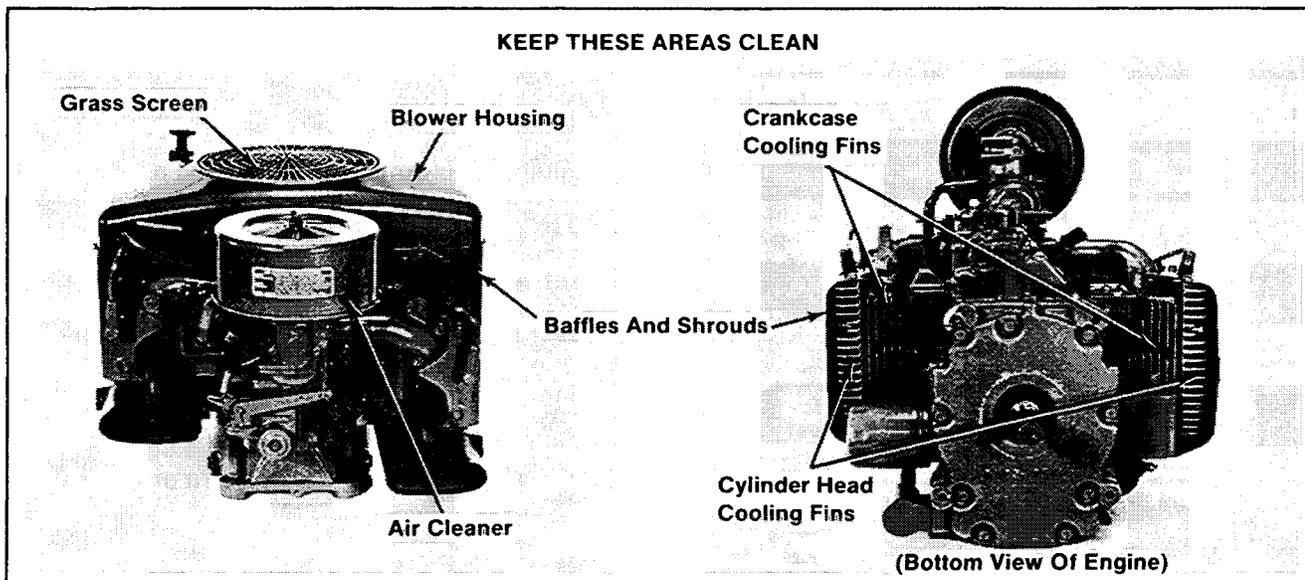


Figure 3-4. Air Intake And Cooling Areas.

- Remove the plugs and check condition. Replace the plugs if worn or if reuse is questionable.

Use Champion® Type RV15YC or equivalent spark plugs.

**CAUTION:** Do not clean the spark plugs in a machine using abrasive grit. Some grit could remain in spark plugs and enter the engine causing extensive wear and damage.

- Check gaps using a wire feeler gauge. Adjust gaps to **0.025"** by carefully bending the ground electrode.
- Reinstall the spark plugs into cylinder heads. Torque plugs to **10/15 ft. lb.**

## IGNITION SYSTEM SERVICE

Magnum engines are equipped with a dependable electronic magneto ignition system. Other than periodically checking/replacing the spark plugs, no maintenance, timing, or adjustments are required with this system.

## CHECK FUEL FILTER (Refer to Figure 3-6.)

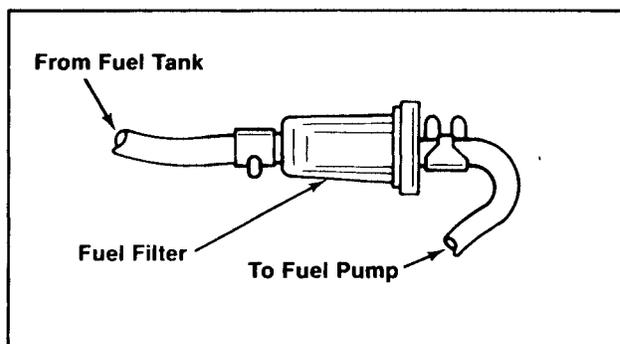


Figure 3-6. In-line Fuel Filter.

Some engines are equipped with an in-line fuel filter. Visually inspect the filter periodically. Replace when dirty with a genuine Kohler filter.

## SERVICE STARTER MOTOR DRIVE

Every 500\* operating hours, or annually (whichever occurs first), clean and lubricate the drive splines of the Bendix-drive electric starter motor. Refer to Figure 3-7.

\*Perform more frequently when operating under dusty and dirty conditions.

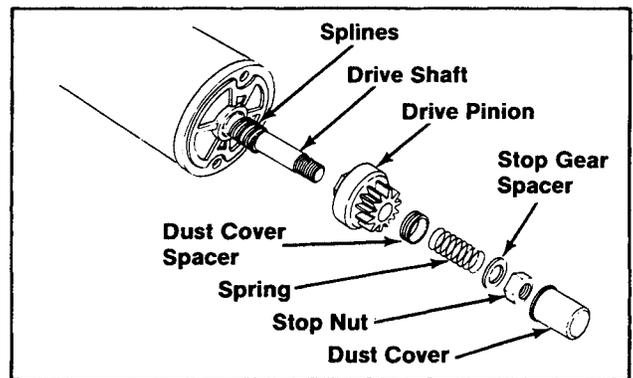


Figure 3-7. Starter Drive Components.

- Remove the starter from crankcase. (Refer to the "Disassembly" section.)
  - Remove the dust cover, stop nut, stop gear spacer, spring, dust cover spacer, and drive pinion.
  - Clean the drive shaft splines with solvent. Dry splines thoroughly.
  - Apply a small amount of Kohler electric starter drive lubricant (Part No. 52 357 01) to splines.
- CAUTION:** Kohler starter drive lubricant (Part No. 52 357 01) must be used on all Kohler electric starter drives. The use of other lubricants can cause the drive to stick or bind.
- Apply a small amount of Loctite® No. 271 to stop nut threads. Assemble the drive parts in reverse order of removal. Torque the stop nut to **160 in. lb.**
  - Reinstall the starter to crankcase.

## CLEAN CYLINDER HEADS AND COMBUSTION CHAMBERS

Every 500 operating hours (250 hours when leaded gasoline is used), remove the cylinder heads and clean the combustion chambers. Refer to Figure 3-8.

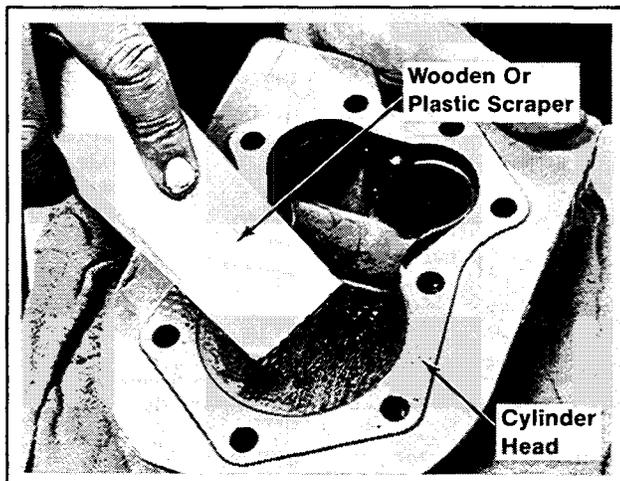


Figure 3-8. Cleaning Cylinder Heads And Combustion Chambers.

1. Remove the cylinder head baffles and cylinder heads.
2. Clean away the combustion deposits using a wooden or plastic scraper.
3. Reinstall the cylinder heads using new gaskets. Torque the cylinder head fasteners to **15/20 ft. lb.** in the sequence specified in Figure 3-9.

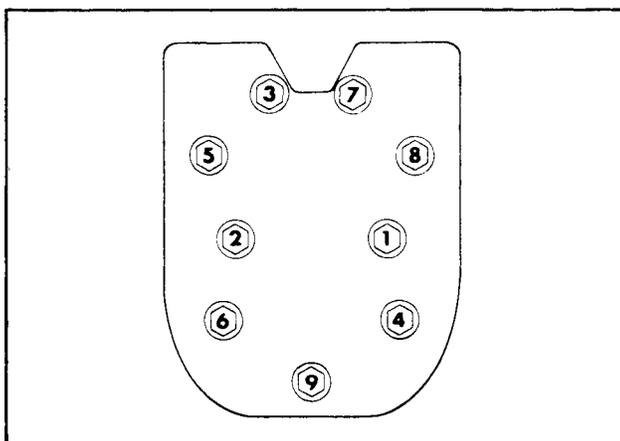


Figure 3-9. Cylinder Head Fastener Tightening Sequence.

## CHECK VALVE-TO-TAPPET CLEARANCE

Every 500 operating hours, remove the breather/valve covers and check valve-to-tappet clearance with a flat feeler gauge. Refer to Figure 3-10. The engine must be cold when checking this clearance.

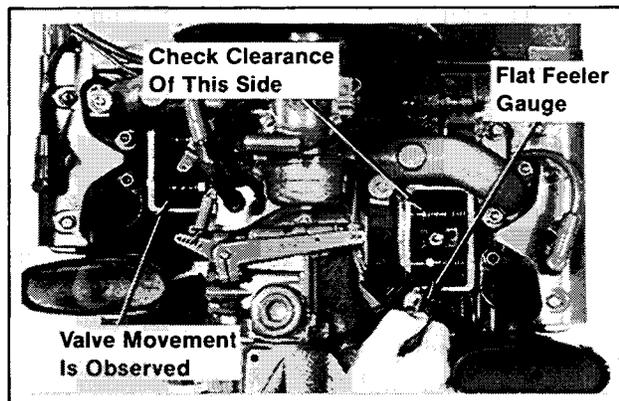


Figure 3-10. Measuring Valve-To-Tappet Clearance.

## Remove Air Cleaner, Valve Covers, Breather, And Spark Plugs

1. Disassemble the air cleaner. Disconnect the breather tube from air cleaner base. Remove the air cleaner base from air intake elbow.
2. Remove the valve cover and breather components from the #1 cylinder barrel. Remove the valve cover from the #2 cylinder barrel.
3. Remove the spark plugs.

## Measure Valve-To-Tappet Clearance

### IMPORTANT:

The piston must be at top dead center (TDC) of the compression stroke to measure valve-to-tappet clearance. By rotating the flywheel and observing the valves and tappets for movement, it can be determined if a cylinder is at TDC.

If, for example, the flywheel is rotated and movement is noticed in the #2 side valve box—the opposite cylinder (#1 side) will be at TDC and valve-to-tappet clearance can be measured.

Rotating the flywheel one complete revolution (360°) will then cause movement in the #1 side valve box—the #2 side cylinder will be at TDC, enabling measurement of valve-to-tappet clearance for that side.

### Clearance Specifications --

	Intake	Exhaust
Before serial no.		
1816500656	.003/.006	.016/.019
After serial no.		
1816500646 but before serial no.1917809296	.003/.006	.011/.014
After serial no.		
1917809286	.003/.006	.013/.016

1. Rotate the flywheel and look into the valve boxes. The valves and tappets will move in only one of the boxes. Measure the valve-to-tappet clearance for the cylinder in which **no movement** was observed—use a flat feeler gauge. Refer to Figure 3-10.
2. Rotate the flywheel 360° and measure the valve-to-tappet clearance for the remaining cylinder.
3. *If clearance is too small*, remove the valves and grind the valve stems until the correct clearance is obtained. Make sure the valve stems are ground perfectly flat and smooth.

*If clearance is too large*, replace the valves and recheck clearance.

NOTE: Large clearances can also be reduced by grinding the valves and/or valve seats. Refer to the "Inspection And Repair/Reconditioning" section for valve specifications.

### **Reinstall Spark Plugs, Breather, Valve Covers, And Air Cleaner**

1. Reinstall the spark plugs and torque to **10/15 ft. lb**
2. Reinstall valve cover to #2 cylinder barrel. Reinstall breather components and breather cover to the #1 cylinder barrel. Make sure the breather is assembled correctly using new gaskets.
3. Reinstall the air cleaner base to intake the air intake elbow using new gasket.
4. Insert the ends of breather tube into holes in air cleaner base and breather cover.

**CAUTION:** Make sure the breather tube seals tightly in breather cover and in air cleaner base to prevent unfiltered air from entering the engine.

5. Reassemble the remaining air cleaner components and tighten wing nut 1/2 to 1 full turn after nut contacts cover. Do not overtighten.

6. Reconnect the spark plug leads.

### **STORAGE**

If the engine will be out of service for approximately two months or more, use the following storage procedure:

1. Change the oil and filter when engine is still warm from operation. Refer to "Change Oil." Run the engine for a few minutes to distribute the clean oil.
2. The fuel system must be completely emptied, or the gasoline must be treated with a stabilizer to prevent deterioration. If you choose to use a stabilizer, follow the manufacturers recommendations, and add the correct amount for the capacity of the fuel system. Fill the fuel tank with clean, fresh gasoline. Run the engine for 2–3 minutes to get stabilized fuel into the carburetor.  
  
To empty the system, drain the fuel tank and carburetor, or run the engine until the tank and system are empty.
3. Remove the spark plugs. Add one tablespoon of engine oil into each spark plug hole. Install plugs, but do not connect plug leads. Crank the engine two or three revolutions.
4. Clean the exterior surfaces of engine. Spread a light film of oil over any exposed metal surfaces of engine to prevent rust.
5. Store the engine in a clean, dry place.

# SECTION 4

## TROUBLESHOOTING

### TROUBLESHOOTING GUIDE

When troubles occur, be sure to check the 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 common causes of engine troubles are listed below—use this as a guide to locate causing factors.

#### Engine Cranks But Will Not Start

1. Empty fuel tank.
2. Fuel shutoff valve closed.
3. Clogged fuel line.
4. Spark plug leads disconnected.
5. Keyswitch or kill switch in "off" position.
6. Faulty spark plugs.
7. Faulty ignition module.
8. Dirt or water in fuel system.

#### Engine Starts But Does Not Keep Running

1. Restricted fuel tank vent.
2. Dirt or water in fuel system.
3. Faulty choke or throttle controls/cables.
4. Loose wires or connections which short kill terminal of ignition module to ground.
5. Carburetor improperly adjusted.
6. Faulty cylinder head gaskets.
7. Faulty fuel pump.

#### Engine Starts Hard

1. Hydrostatic transmission is not in neutral/PTO drive is engaged.
2. Loose wires or connections.
3. Dirt or water in fuel system.
4. Clogged or restricted fuel lines.
5. Faulty choke or throttle controls/cables.
6. Faulty spark plugs.
7. Carburetor improperly adjusted.
8. Incorrect valve-to-tappet clearance.
9. Low compression.

#### Engine Will Not Crank

1. Hydrostatic transmission is not in neutral/PTO drive is engaged.
2. Battery is discharged.
3. Safety interlock switch is "engaged".
4. Loose or faulty wires or connections.
5. Faulty keyswitch or ignition switch.
6. Faulty electric starter/starter solenoid.
7. Seized internal engine components.

#### Engine Runs But Misses

1. Dirt or water in fuel system.
2. Spark plug leads loose.
3. Loose wires or connections which intermittently short kill terminal of ignition module to ground.
4. Carburetor improperly adjusted.
5. Engine overheating.
6. Incorrect valve-to-tappet clearance.
7. Faulty ignition module.

#### Engine Will Not Idle

1. Idle speed adjusting screw improperly set.
2. Dirt or water in fuel system.
3. Idle fuel adjusting screw improperly set.
4. Restricted fuel tank vent.
5. Faulty spark plugs.
6. Incorrect valve-to-tappet clearance.
7. Low compression.

#### Engine Overheats

1. Grass screen, cooling fins, or shrouding clogged.
2. Excessive engine load.
3. Low crankcase oil level.
4. High crankcase oil level.
5. Carburetor improperly adjusted.

#### Engine Knocks

1. Low crankcase oil level.
2. Excessive engine load.

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### Engine Loses Power

1. Low crankcase oil level.
2. High crankcase oil level.
3. Restricted air cleaner element.
4. Dirt or water in fuel system.
5. Excessive engine load.
6. Engine overheating.
7. Faulty spark plugs.
8. Carburetor improperly adjusted.
9. Low compression.

### Engine Uses Excessive Amount of Oil

1. Incorrect oil viscosity or type.
2. Clogged or improperly assembled breather system.
3. Worn or broken piston rings.
4. Worn cylinder bores.
5. Worn valve stems and/or valve guides.

## EXTERNAL ENGINE INSPECTION

Before cleaning or disassembling the engine, check its external appearance and condition. This inspection can give clues to what might be found inside the engine (and the cause) once it is disassembled.

- Check for buildup of dirt and debris on the crankcase, cooling fins, grass screen, and other external surfaces. Dirt or debris in these areas are causes of overheating.
- Check for obvious fuel and oil leaks, and damaged components. Excessive oil leakage can indicate a clogged or improperly assembled breather, worn or damaged seals and gaskets, or loose or improperly torqued fasteners.
- Check the air cleaner cover, element cover, and air cleaner base for damage or indications of improper fit and seal. Also check the seal on the air cleaner cover wing nut. A missing or damaged seals could allow dirt to enter the engine.
- Check the air cleaner element. Look for holes, tears, cracked or damaged sealing surfaces, or other damage that could allow dirt to enter the engine. Also note if the element is clogged or restricted. These could indicate that the air cleaner has been underserviced.
- Check the carburetor throat for dirt. Dirt in the throat is further indication that the air cleaner is not functioning properly.
- Check the oil level. Note if the oil level is within the operating range on the dipstick, or if it's low or overfilled.

- Check the condition of the oil. Drain the oil into a container—it should flow freely. Check for metal chips and other foreign particles.

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

Sludge is a natural by-product of combustion; a small accumulation is normal. Excessive sludge formation could indicate that the oil has not been changed as recommended, an incorrect type or weight of oil was used, overrich carburetor settings, and weak ignition, to name a few.

## CLEANING THE ENGINE

After inspecting the external condition of the engine, clean it thoroughly before disassembling. Also clean individual components as the engine is disassembled. Only clean parts can be accurately inspected and gauged for wear or damage.

There are many commercially available cleaners that quickly remove grease, oil, and grime from engine parts. When such a cleaner is used, *follow the manufacturer's instructions carefully*. Make sure all traces of the cleaner are removed before the engine is reassembled and placed in operation. Even small amounts of these cleaners quickly break down the lubricating properties of engine oil.

## BASIC ENGINE TESTS

### Crankcase Vacuum

A partial vacuum should be present in the crankcase when the engine is operating at normal temperatures. Pressure in the crankcase (usually 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 a slack tube manometer. The manometer included in the Kohler Engine Analysis kit is recommended. Refer to the "Special Tools" section for more information.

### Crankcase Vacuum Test

To test crankcase vacuum with the manometer:

1. Insert the stopper/hose into the oil fill hole. Leave the other vent of manometer open to atmosphere. Make sure the shutoff clamp is closed.
2. Start the engine and run at high speed (3200 to 3750 RPM).
3. Open the clamp and note the water level in the tube. The level in the engine side should be **7 to 14 in.** above the level in the open side. If there is no vacuum (level in engine side is the same as open side) or a positive pressure (level in open side is higher than engine side) check for the conditions below.
4. Close the shutoff clamp **before** stopping the engine.

#### NO CRANKCASE VACUUM/PRESSURE IN CRANKCASE

Possible Cause	Solution
1. Crankcase breather clogged or inoperative.	1. Disassemble breather, clean parts thoroughly, reassemble, and recheck pressure.
2. Seals and/or gaskets leaking. Loose or improperly torqued fasteners.	2. Replace all worn or damaged seals and gaskets. Make sure fasteners are tightened securely. Use appropriate torque values and sequences when necessary.
3. Piston blowby or leaky valves. (Confirm by testing compression.)	3. Recondition pistons, rings, cylinder bores, valves, and valve guides.
4. Restricted exhaust.	4. Replace restricted muffler/exhaust system.

### Compression Test

To test compression:

1. Remove the spark plugs. Install compression tester in each spark plug hole.
2. Set the throttle and choke controls to the wide open position. Make sure air cleaner and exhaust system are not restricted.
3. Crank the engine using the starting motor. Take several readings for both cylinders.  
  
If the difference in pressure between cylinders is 15% or greater, or pressure is less than 90 psig, check for the conditions below:

#### LOW COMPRESSION

Possible Cause	Solution
1. Blown cylinder head gaskets.	1. Remove cylinder heads, inspect heads for flatness (replace heads if necessary), replace gaskets, reinstall heads, and recheck compression. Locate and correct the cause of initial failure.
2. Warped or loose cylinder heads.	2. Remove cylinder heads, check for flatness (replace heads if necessary). Make sure cylinder head fasteners are torqued in the proper sequence to the proper value.
3. Excessive combustion chamber deposits.	3. Remove cylinder heads and clean deposits from combustion chamber.
4. Worn piston rings - blowby occurring.	4. Recondition piston rings and cylinder bores.
5. Worn valves.	5. Recondition valves and valve seals.

# SECTION 5 AIR CLEANER

These engines are equipped with a high-density paper air cleaner element. Some specifications are also equipped with an oiled foam precleaner which surrounds the paper element. Refer to Figure 5-1, 5-2, and 5-3.

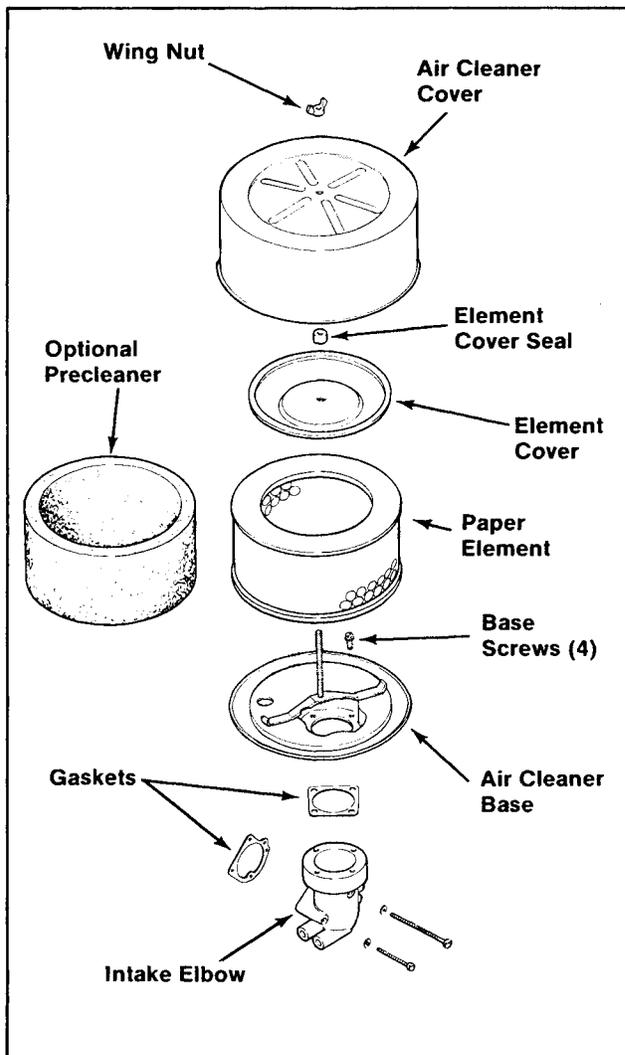


Figure 5-1. Air Cleaner Components—Exploded View.

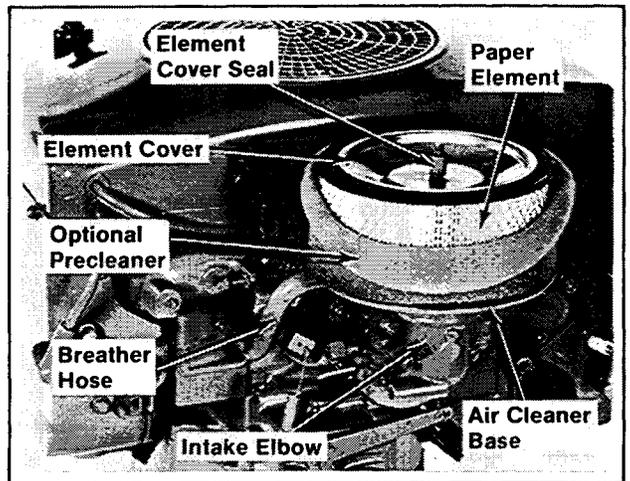


Figure 5-2. Air Cleaner Components.

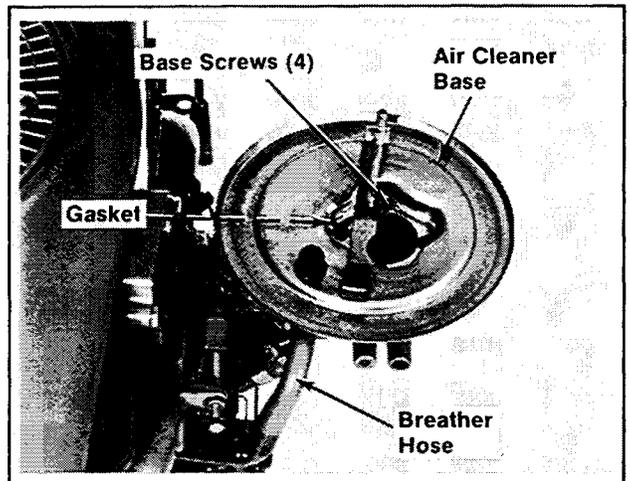


Figure 5-3. Air Cleaner Components.

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## DISASSEMBLY

1. Remove the wing nut and air cleaner cover.
2. Remove the element cover seal, element cover, paper element, and precleaner (if so equipped).
3. Remove the breather hose, base screws, air cleaner base, and gasket.

## REASSEMBLY

1. Install the gasket, air cleaner base, base screws, and breather hose.

**CAUTION:** Make sure the breather hose seals tightly in the air cleaner base and breather cover to prevent unfiltered air from entering the engine.

2. Install the paper element, precleaner (cleaned and oiled), element cover, and element cover seal.
3. Install the air cleaner cover and wing nut. Tighten wing nut 1/2 to 1 full turn after nut contacts cover—do not overtighten.

## SERVICE

### Precleaner

If so equipped, wash and reoil the precleaner every 25 operating hours (more often under extremely dusty or dirty conditions).

1. Remove the precleaner from paper element. Wash the precleaner in warm water with detergent.
2. Rinse the precleaner thoroughly until all traces of detergent are eliminated. Squeeze out excess water (do not wring). Allow precleaner to air dry.
3. Saturate the precleaner in clean, fresh engine oil. Squeeze out excess oil.
4. Reinstall the precleaner over the paper element.

### Paper Element

Every 100 operating hours (more often under extremely dusty or dirty conditions) check the paper element. Replace the element as follows:

1. Remove the precleaner (if so equipped), element cover seal, element cover, and paper element.

2. Replace a dirty, bent or damaged element with a new genuine Kohler element. Handle new elements carefully; do not use if surfaces are bent or damaged.

**CAUTION:** Do not wash the paper element or use compressed air as this will damage the element.

3. Reinstall the precleaner (cleaned and oiled) over the paper element.
4. Reinstall the paper element, element cover, and element cover seal. Make sure the element is sealed tightly against the element cover and air cleaner base.
5. Install the air cleaner cover and wing nut. Tighten wing nut 1/2 to 1 full turn after nut contacts cover—do not overtighten.

### Inspect Air Cleaner Components

Whenever the air cleaner cover is removed, or servicing the element or precleaner, check the following components:

- **Air Cleaner Base** - Make sure it seals tightly against intake elbow, and is not bent or damaged.
- **Element Cover and Element Cover Seals** - Make sure element cover is not bent or damaged. Make sure element cover seals are in place to ensure element is sealed tightly between element cover and air cleaner base.
- **Breather Tube** - Make sure it is sealed tightly in air cleaner base and breather cover.

**CAUTION:** Damaged, worn, or loose air cleaner components could allow unfiltered air into the engine causing premature wear and failure. Replace all damaged or worn components.

# SECTION 6 FUEL SYSTEM AND GOVERNOR

## FUEL SYSTEM

The typical fuel system and related components include the fuel tank with vented cap, in-line fuel filter, fuel pump, carburetor, and interconnecting fuel line. Refer to Figure 6-1.

### Operation

The fuel from the tank is moved through the in-line filter and fuel lines by the fuel pump. Fuel then enters the carburetor float bowl and is moved into the carburetor body where it is mixed with air. This fuel-air mixture is then burned in the engine combustion chambers.

## Troubleshooting

Use the following procedure to check if fuel is reaching the combustion chamber.

### WARNING: Explosive Fuel!



*Gasoline is extremely flammable and its vapors can explode if ignited. Before troubleshooting the fuel system, make sure there are no sources of heat, flames, or sparks nearby as these can ignite gasoline vapors. Disconnect and ground the spark plug leads to eliminate the possibility of sparks from the ignition system.*

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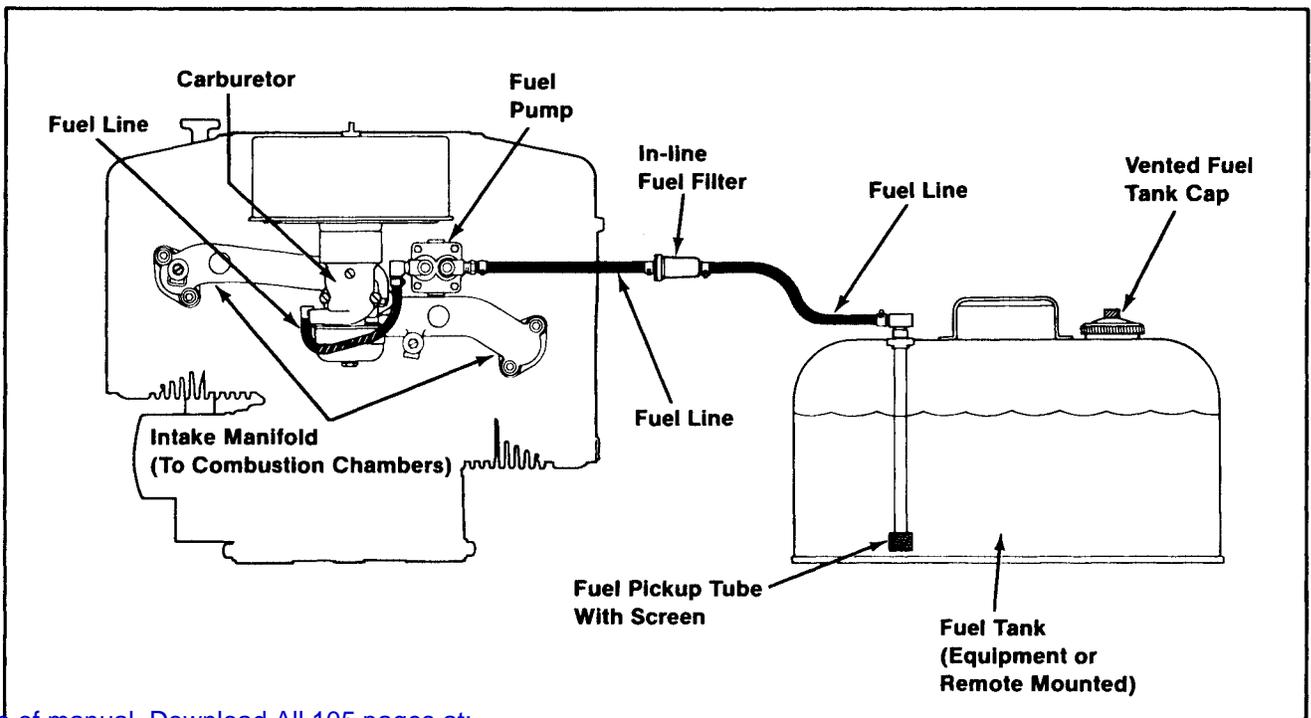


Figure 6-1 Typical Fuel System