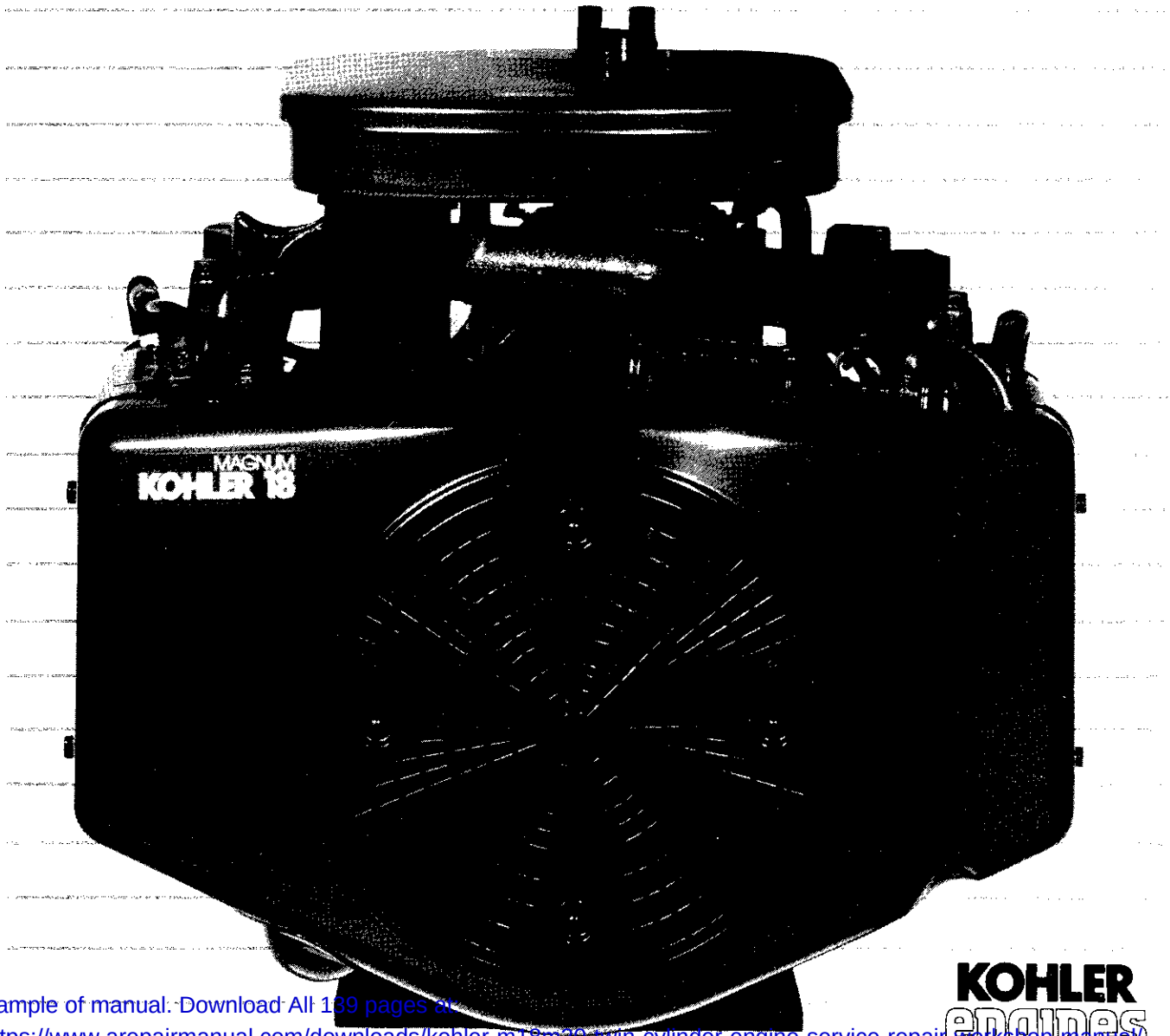
twin cylinder engine

SERVICE MANUAL

MAGNUM

MODELS M18 & M20



KOHLER engines

TP-2204-B

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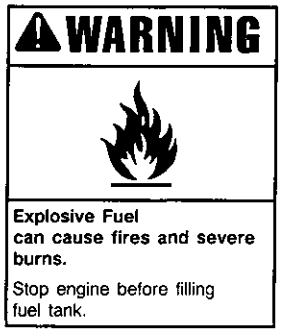
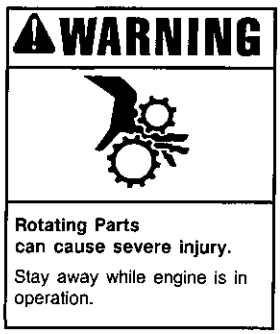
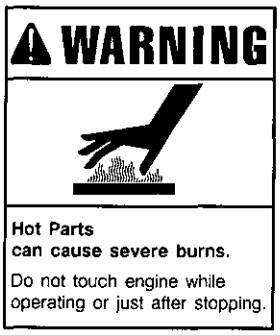
SECTION 1
SAFETY AND GENERAL INFORMATION

SAFETY INFORMATION

For Your Safety!
These precautions should be followed at all times. Failure to follow these precautions could result in injury to yourself and others.







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.

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.

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.

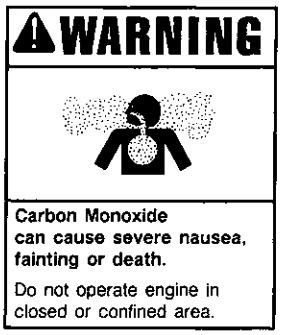
SECTION 1
SAFETY AND GENERAL INFORMATION

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.

CAUTION: High Voltage!
Never touch electrical wires or components while the engine is running. They can be sources of electrical shock.

WARNING: Overspeed Is Hazardous!
Do not tamper with the governor setting. Overspeed is hazardous and could cause personal injury.

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.

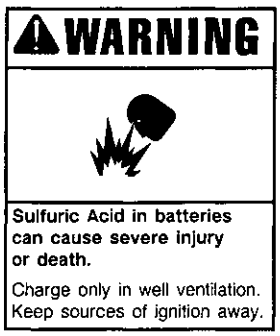


Lethal Exhaust Gases!
Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled. Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area.

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.

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

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



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.

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.

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:

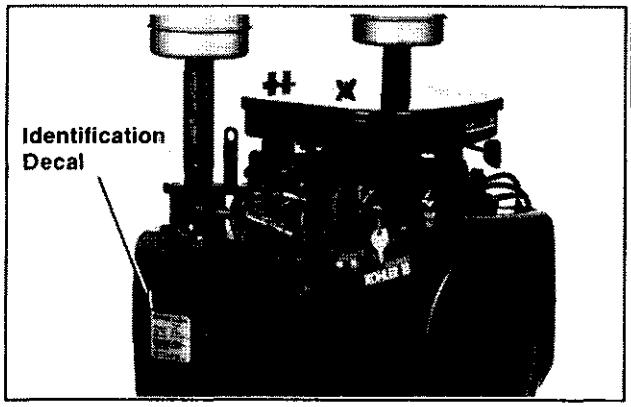


Figure 1-1. Location of Engine Identification Decal.

A. MODEL NO. **M 18 S**

Magnum Engine

Horsepower

Version Code
S-Electric Start
G-Tapered Crankshaft (Generator Application)
P-Threaded Crankshaft (Pump Application
EP-Generator
Q-Quiet Model

B. SPEC. NO. **24501**

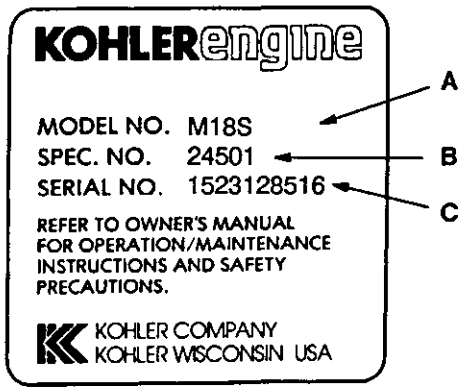
Engine Model Code — **Variation Of Basic Engine**

Code*	Model
245	M18
495	M20

C. SERIAL NO. **1523128516**

Year Manufactured — **Factory Code**

15	1985
16	1986
17	1987
18	1988
19	1989
20	1990
21	1991
22	1992
23	1993
24	1994
25	1995



*NOTE: Engine model codes with a 3rd digit of 5 or greater denote MAGNUM engines.

Figure 1-2. Engine Identification Decals.

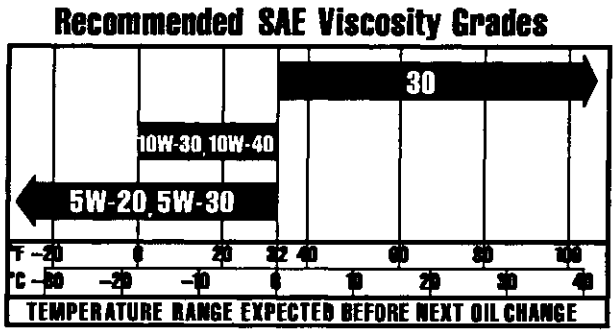
SECTION 1
SAFETY AND GENERAL INFORMATION

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

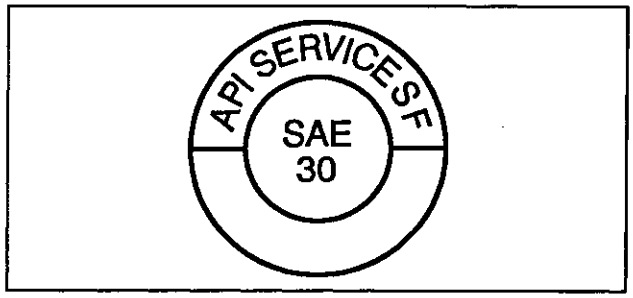
Use high-quality detergent oil of API (American Petroleum Institute) Service Class SF or SG. Select the viscosity based on the air temperature at the time of operation as shown in the table.



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.

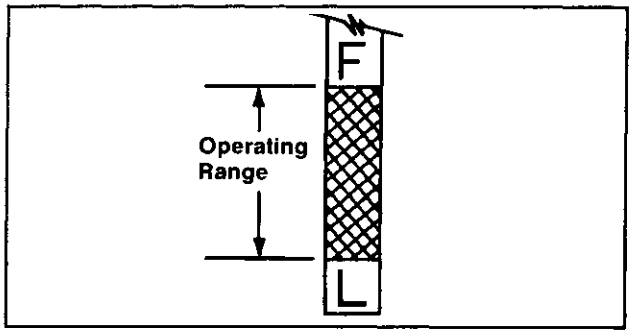
A logo or symbol on oil containers identifies the API service class and SAE viscosity grade.



Check Oil Level

Check oil level BEFORE EACH USE.

NOTE: Do not operate the engine with the oil level below "L" mark or over "F" mark on dipstick.



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 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. Refill with Service Class SF or SG oil as specified in the table.

OIL CHANGE INTERVALS

Temperature	Oil Type	Engine Type	Interval
ABOVE 32°F (0°C)	SAE 30	With Filter	50 Hours*
		Without Filter	25 Hours
BELOW 32°F (0°C)	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.

FUEL RECOMMENDATIONS

WARNING: Explosive Fuels!

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 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 engine near spilled fuel; wipe up spills immediately. Never use gasoline as a cleaning agent.

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.

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

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.

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 maximum of 15% MTBE by volume) are approved as a fuel for Kohler engines. Other gasoline/ether blends are not approved.

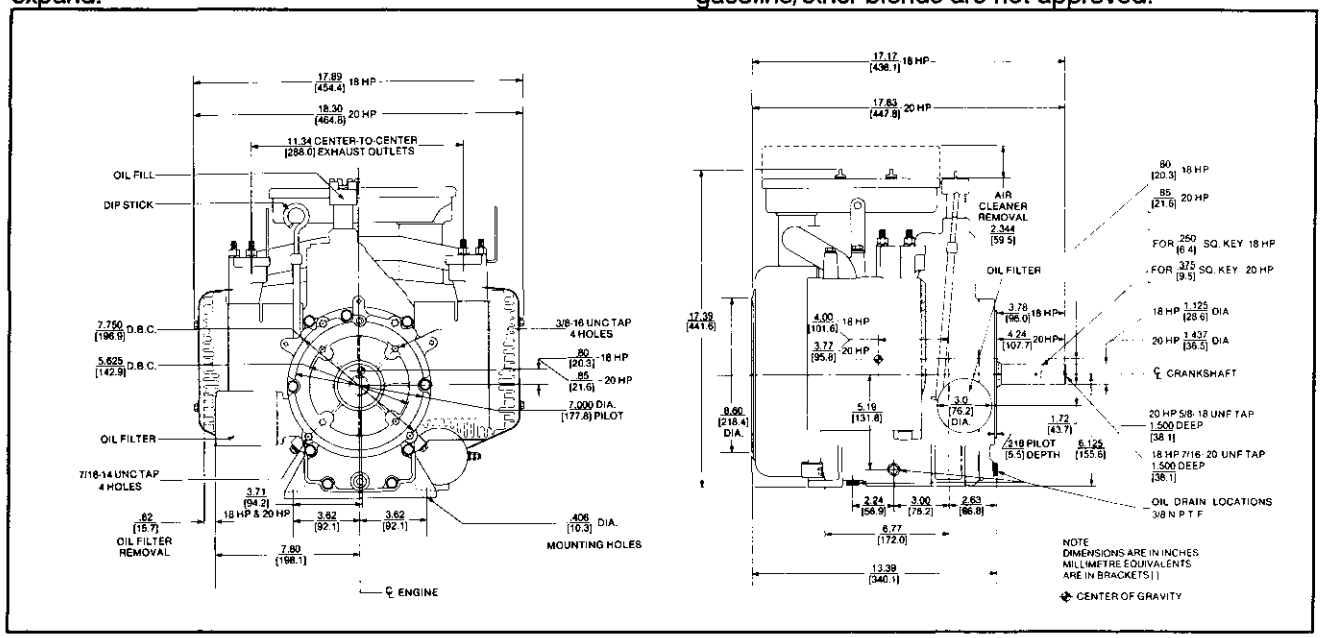


Figure 1-3. Overall Dimensions--Model M18 and M20.

SECTION 1
SAFETY AND GENERAL INFORMATION

SPECIFICATIONS, TOLERANCES, AND SPECIAL TORQUE VALUES[2]

DESCRIPTION	Model M18	Model M20
General Specifications		
Horsepower (@ 3,600 RPM)	18	20
Displacement (cu. in.)	42.18	46.98
Bore	3.12	3.12
Stroke	2.75	3.06
Compression Ratio	6.0:1	6.6:1
Approx. Weight (lb.)	130	130
Approx. Oil Capacity* (U.S. Quarts)	1.5	1.5

* 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.

Angle of Operation - Maximum (At Full Oil Level; Intermittent Operation)		
Carb. Side Up	#1Cyl. Up 35°	#1 Cyl. Up 35°
Carb. Side Down	#1 Cyl. Down 35°	#1 Cyl. Down 35°
Flywheel End Up	30°	30°
Flywheel End Down	30°	30°
Camshaft		
End Play	.003/.013	.003/.013
Camshaft to Camshaft Bearing		
Running Clearance	.0010/.0025	.0010/.0025
Carburetor		
Preliminary Main Fuel		
Screw Setting (Turns)	2-1/2	2-1/2
Preliminary Idle Fuel		
Screw Setting (Turns)	1	1
Float Level	11/64 (+ or - 1/32)	11/64 (+ or - 1/32)
Float Drop	1-1/32	1-1/32
Fuel Inlet Seat Torque (in. lb.)	35	35
Bowl Retaining Screw Torque (in. lb.)	50	50
Float to Float Pin Tower Clearance	.010	.010

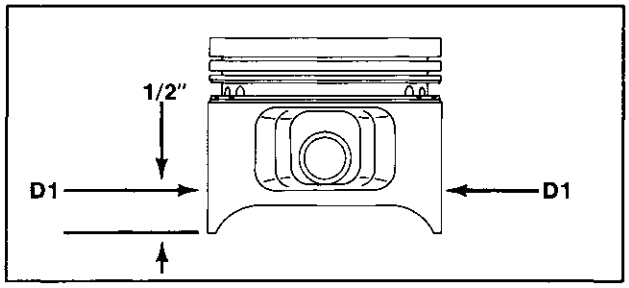
	Model M18	Model M20
Connecting Rod (Posi-Lock)		
New Service Rod Nut Torque (in. lb.)[4,6]	140	140
Used Rod Nut Torque (in. lb.)[4,6]	100	100
Rod to Crankpin Running Clearance - New	.0012/.0024	.0012/.0024
Rod to Crankpin Max. Wear Limit	.0029	.0029
Rod to Piston Pin Running Clearance - New	.0006/.0011	.0006/.0011
Rod to Side Play on Crankpin	.005/.016	.005/.016
Crankcase/Cylinder Barrel		
Intake and Exhaust Manifold Fastener		
Torque (in. lb.)	150	150
Closure Plate Fastener Torque (in. lb.)[7]	150	150
Closure Plate Oil Gallery Pipe Plug		
Torque (in. lb.)	65/80	65/80
Cylinder Barrel Nut Torque (in. lb.)[7]	200	200
Crankcase Nut Torque (in. lb.)[7]	260	260
5/16" Crankcase Screw Torque (in. lb.)[7]	200	200
3/8" Crankcase Screw Torque (in. lb.)[7]	260	260
Crankshaft		
Crankshaft End Play	.002/.014	.002/.014
Main Bearing Surface Max. Wear Limit	1.7407	1.7407
Sleeve Bearing Max. Out of Round	.0005	.0005
Sleeve Bearing Max. Taper	.001	.001
New Sleeve Bearing Max. Running Clearance	.0049	.0049
Sleeve Bearing Running Clearance Max. Wear Limit	.0059	.0059
New Sleeve Bearing I.D. (installed)	1.7439/1.7461	1.7439/1.7461
Crankpin O.D. - New	1.3733/1.3738	1.4993/1.4998
Crankpin O.D. Max. Wear Limit	1.3728	1.4988
Crankpin O.D. Max. Out of Round	.0005	.0005
Crankpin O.D. Max. Taper	.001	.001

	Model M18	Model M20
Cylinder Bore		
I.D. - New	3.1245/3.1255	3.1245/3.1255
I.D. Max. Wear Limit	3.128	3.128
I.D. Max. Out of Round	.002	.002
I.D. Max. Taper	.0015	.0015
Cylinder Head		
Cap Screw Torque (ft. lb.)[4]	15/20	15/20
Max. Out of Flatness	.003	.003
Fan/Flywheel		
Fan Fastener Torque (in. lb.)	115	115
Flywheel Fastener Torque (ft. lb.)[4]	40	40
Fuel Pump		
Mounting Screw Torque (in. lb.)	40/45	40/45
Ignition		
Ignition Module to Magnet Air Gap	.008/.012	.008/.012
Spark Plug Type (Champion® or Equiv.)	RV17YC	RV17YC
Spark Plug Gap	0.035	0.035
Spark Plug Torque (ft. lb.)	10/15	10/15
Oil Fill/Oil Filter[10]		
#52 173 01 Oil Fill Cap Torque (in. lb.)	30/45	30/45
Engine Mtd. Filter Adapter Fastener Torque (in. lb.)	125	125
Remote Oil Filter Cover Fastener Torque (in. lb.)	125	125
Remote Oil Line Fitting Nut Torque (in. lb.)	65/80	65/80
Remote Oil Line Reducing Connector Torque (in. lb.)	65/80	65/80
Remote Oil Line Flare Nut Torque (in. lb.)	100/120	100/120
Remote Oil Filter Adapter Fitting Torque (in. lb.)	90/130	90/130
Oil Filter Installation Torque (in. lb.)	50/80	50/80
Oil Filter Bypass Cover Fastener Torque (in. lb.)	125	125
Oil Pump		
Pump Shaft to Crankcase Running Clearance	.0010/.0026	.0010/.0026
Pump Drive Gear End Play	.010/.029	.010/.029

	Model M18	Model M20
Piston and Piston Rings (Style "D" Pistons)		
Thrust Face O.D. @ D1 - New[9]	3.1203/3.1210	3.1208/3.1215
Thrust Face O.D. @ D1 - Max. Wear Limit[9]	3.1181	3.1186
Thrust Face to Bore Clearance @ D1 - New[9]	.0035/.0052	.0030/.0047
Piston Ring End Gap - New[8]	.010/.023	.010/.023
Piston Ring End Gap - Used (Max.)[8]	.032	.032
Piston Ring Side Clearance - Max.	.006	.006
Piston Pin O.D. - New	.6247/.6249	.7499/.7501
Valves and Tappets		
Intake Valve to Tappet Clearance - Cold	.003/.006	.003/.006
Exhaust Valve to Tappet Clearance - Cold		
(Serial No. 1816500646 and earlier)	.016/.019	.016/.019
(Serial No. 1816500656 and later)	.011/.014	.011/.014
Intake Valve Minimum Lift - Zero Lash	.274	.274
Exhaust Valve Minimum Lift - Zero Lash	.274	.274
Intake Valve Minimum Stem O.D.	.3103	.3103
Exhaust Valve Minimum Stem O.D.	.3088	.3088
Nominal Valve Seat Angle		
(Serial No. 1816500646 and earlier)	45°	45°
(Serial No. 1816500656 and later)	30°	30°
Valve Guide Reamer Size	.3125	.3125
Intake Valve Guide I.D. Max. Wear Limit	.005	.005
Exhaust Valve Guide I.D. Max. Wear Limit	.007	.007

NOTES:

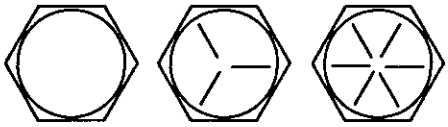
1. Use standard torque values when specific values are not given. Standard values have a tolerance of (+ or -) 20%.
2. All dimensions are in inches unless otherwise specified.
3. Also applies to self-tapping screws.
4. Lubricate with oil at assembly.
5. 3/8-16 thread with hex. head nut and fiber gasket.
6. Torque in increments to the value specified. Do not overtorque--do not loosen and retorque 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.

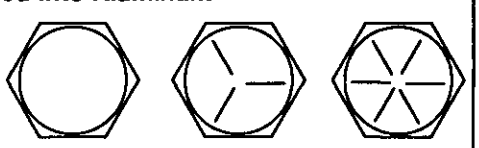
STANDARD TORQUE VALUES[1]

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



Size	Grade 2	Grade 5[3]	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[4]

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[5]	20/25 ft. lb.	20/25 ft. lb.

Conversions

ft. lb. = in. lb. x 0.083
in. lb. = ft. lb. x 12
kgm = ft. lb. x 0.1383
N•m = ft. lb. x 1.3558

SECTION 2
SPECIAL TOOLS

SPECIAL SERVICE TOOL KIT NO. 3211

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. 3211 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.

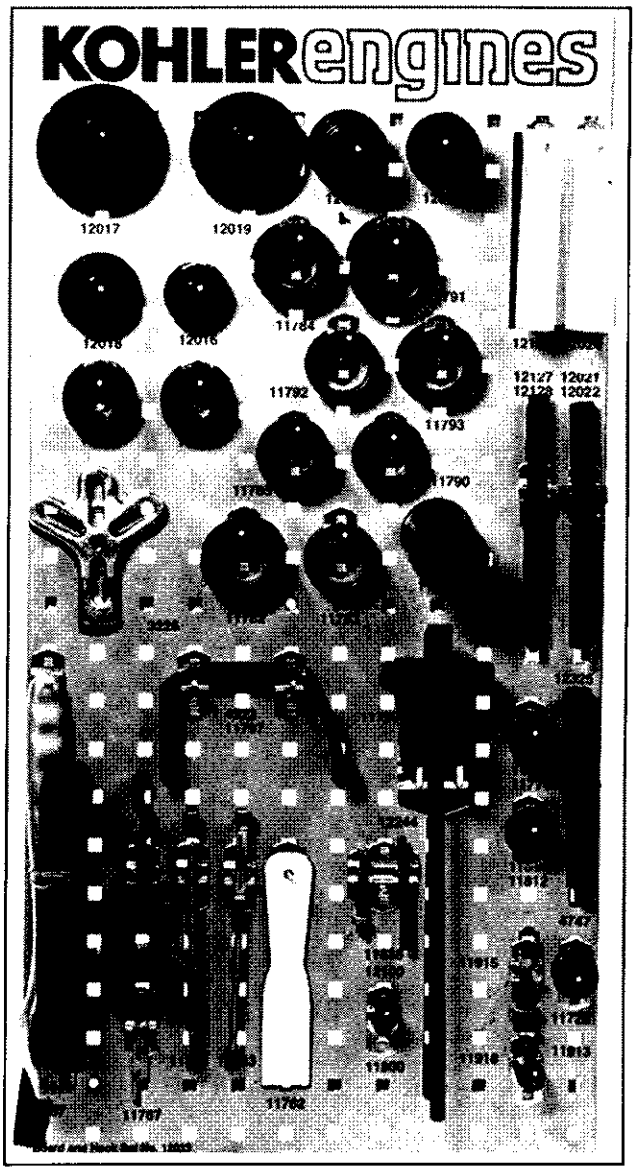
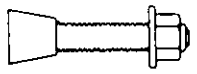
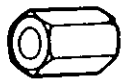
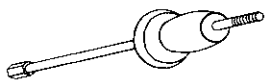
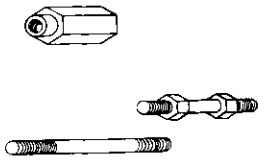
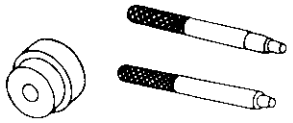
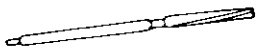
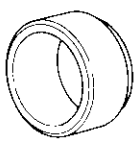
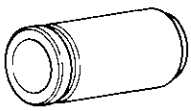
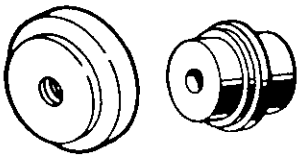


Figure 2-1. Special Service Tool Kit--No. 3211.

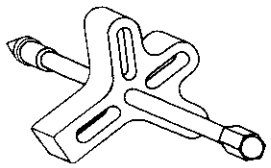
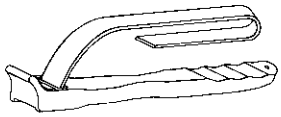
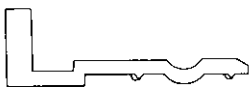
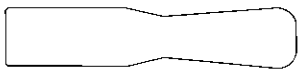
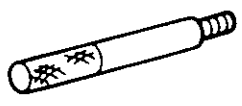
SECTION 2
SPECIAL TOOLS

VALVE SERVICE TOOLS		
TOOL NO. & NAME	**APPLICATION**	**ILLUSTRATION**
VALVE SEAT PULLERS 11726 11913	Removal of valve seats, use 11918 adapter, 3222 slide hammer & 11915 forcing screw	
FORCING SCREW 11915	Used with valve seat pullers 11726 & 11913	
ADAPTER 11918	Used to connect valve seat pullers to slide hammer	
VALVE SEAT INSTALLER 11811 11812	Used to install intake and exhaust seats. Use with 4747 handle.	
3222 SLIDE HAMMER 11799 Weight 12244 Slide Bolt	Provides pulling force for valve seat and guide removal. Use 4747 handle.	
3268 VALVE GUIDE REMOVAL KIT 11838 Stud 3 1/2" 12100 Stud 2 1/2" 11800 Adapter 0917 Nut 12008 Nut	Used to pull valve guides with 3222 slide hammer.	
3224 VALVE GUIDE INSTALLER KIT 12325 Driver 11763 Driver 11770 Gauge 11771 Gauge	Used to install valve guides to proper depth. Use 11763 driver with 11770 & 11771 depth gauges.	
REAMERS (Valve Guide) 11843 5/16" 11844 1/4"	To ream valve guides.	
SEAL AND BEARING INSTALLERS		
3223 SEAL INSTALLER KIT 11782 Seal Installer 11783 Seal Installer 11784 Seal Installer 11785 Seal Installer 11786 Seal Installer 11787 Seal Installer 11790 Seal Installer 11791 Seal Installer 11792 Seal Installer 11793 Seal Installer 11795 Handle	Used to install seals without damage and to proper depth. Use 11795 handle with installers.	 

SEAL AND BEARING INSTALLERS

TOOL NO. & NAME	APPLICATION	ILLUSTRATION
3242 SEAL PROTECTOR SLEEVE KIT 12020 .75" 12021 1.00 12022 1.25 12126 1.12 12127 1.50 12128 1.44	Used on crankshaft when installing seals to prevent damage.	
3241 BEARING INSTALLING KIT 12014 Ins. (Crank Bushing) 12015 Ins. (Cam Bushing) 12016, 12017, 12018 & 12109 Brg. Installers	Used to install & remove engine bearings and bushings.	

OTHER APPLICATIONS

3226 FLYWHEEL PULLER KIT 12485 Puller w/forcing screw 5108 Bolt - 1/4" w/washer (3) 12505 Bolt - 10-24 w/washer (2) 12504 Bolt - 3/8" w/washer (2) 12506 Storage Bag	Used to remove flywheels and bearing plates from engine.	
FLYWHEEL STRAP WRENCH 10357	Used to hold flywheel for nut removal.	
OFFSET WRENCH 11797 Wrench 1/2" 4923 Wrench 9/16"	Used to remove & install cylinder barrel retaining nuts.	
FEELER GAUGE 11767	Used to set oil pump drive gear backlash on twin cylinder engine.	
TIMING GAUGE 10355 Timing Gauge	Used to hold balance gears in timed position when assembling engine.	
SCRAPER 11762	Used to scrape machined surfaces without damage.	
HANDLE 4747 Handle	Used with bearing installers, slide hammer, and valve seat installers.	
TOOL BOARD AND HOOK SET 12033	Used to store and identify tools.	**SEE FRONT PAGE**

TOOL USAGE CHART
KIT NO. 3211

VALVE TOOLS		
PART NO. & NAME	**M18**	**M20**
11726 Valve Seat Puller	●	●
11915 Forcing Screw	●	●
11918 Adapter	●	●
11811 Valve Seat Installer	●	●
3222 Slide Hammer	●	●
3268 Valve Guide Removal Kit	●	●
11763 Valve Guide Driver (depth)	●	●
11770 Valve Guide Depth Gauge	●	
11771 Valve Guide Depth Gauge		●
11843 Valve Guide Reamer 5/16"	●	●
BEARING AND SEAL INSTALLERS		
11782 Installer - Seal (PTO)	●	●
11783 Installer - Seal (Flywheel)	●	●
11795 Handle - Installer Seal	●	●
12020 Seal Sleeve	USE AS REQUIRED	
12021 Seal Sleeve	USE AS REQUIRED	
12022 Seal Sleeve	USE AS REQUIRED	
12126 Seal Sleeve	USE AS REQUIRED	
12127 Seal Sleeve	USE AS REQUIRED	
12128 Seal Sleeve	USE AS REQUIRED	
MISCELLANEOUS TOOLS		
10357 Flywheel Strap Wrench 1/2"	●	●
11797 Offset Wrench 1/2"	●	●
11762 Scraper	●	●
4747 Drive Handle	●	●
3226 Flywheel Puller Kit	●	●

ENGINE ANALYSIS KIT NO. KO-1000

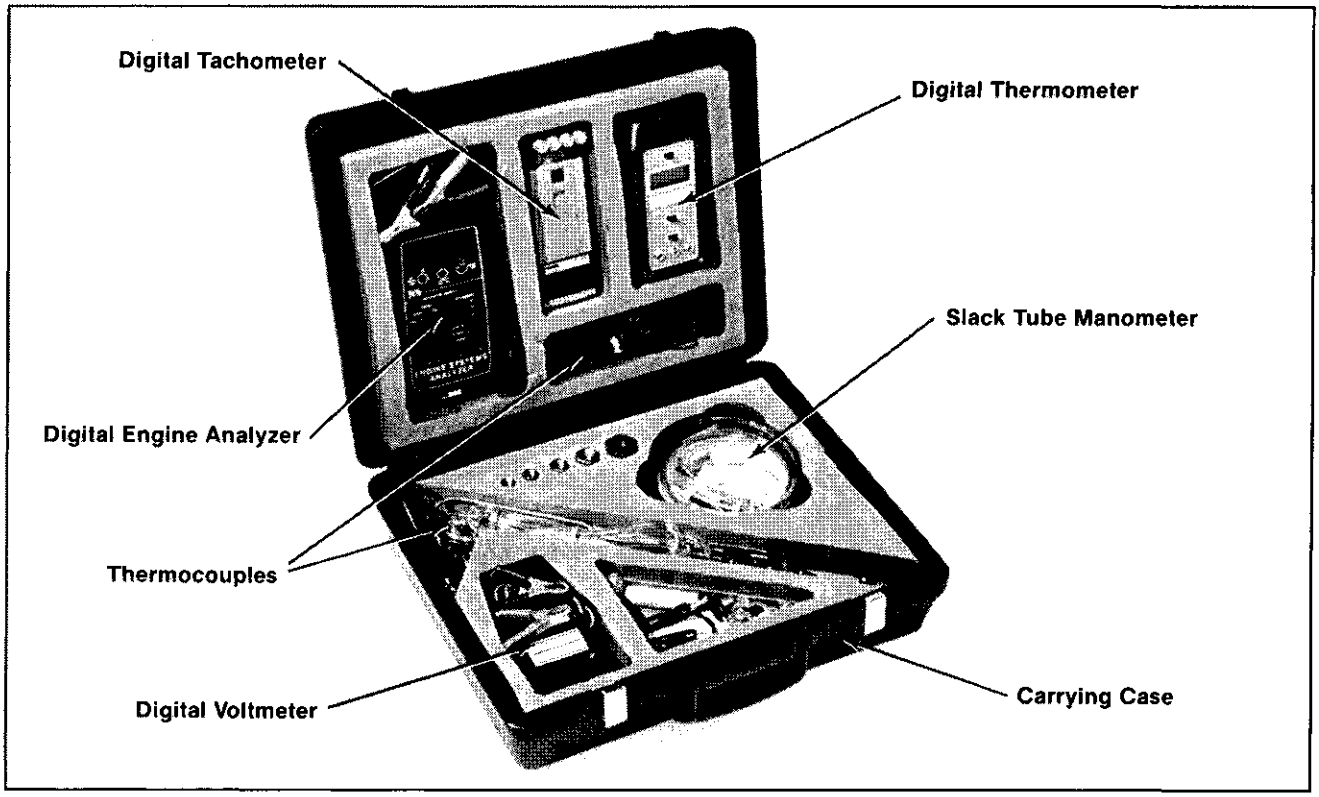


Figure 2-2. Engine Analysis Kit No. - KO-1000

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	KO-1001
1	Digital Tachometer	KO-1002
1	Digital Thermometer	KO-1004
1	Digital Engine Analyzer	KO-1003
1	Slack Tube Manometer	KO-1005
1	8 ft. Lead With Plug	KO-1006
3	14 mm Spark Plug Thermocouple	KO-1007
2	Head Bolt Thermocouple	KO-1008
1	Oil Sump Thermocouple	KO-1009
1	1/4" x 1/8" Bushing	KO-1010-B
1	3/8" x 1/8" Bushing	KO-1010-A
1	1/2" x 1/8" Bushing	KO-1010-C
1	3/4" x 1/8" Bushing	KO-1010-D
1	Tube With Fittings	KO-1011-B
1	Carrying Case	KO-1013
3	Plain Thermocouple	KO-1015

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.

SECTION 2
SPECIAL TOOLS

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.

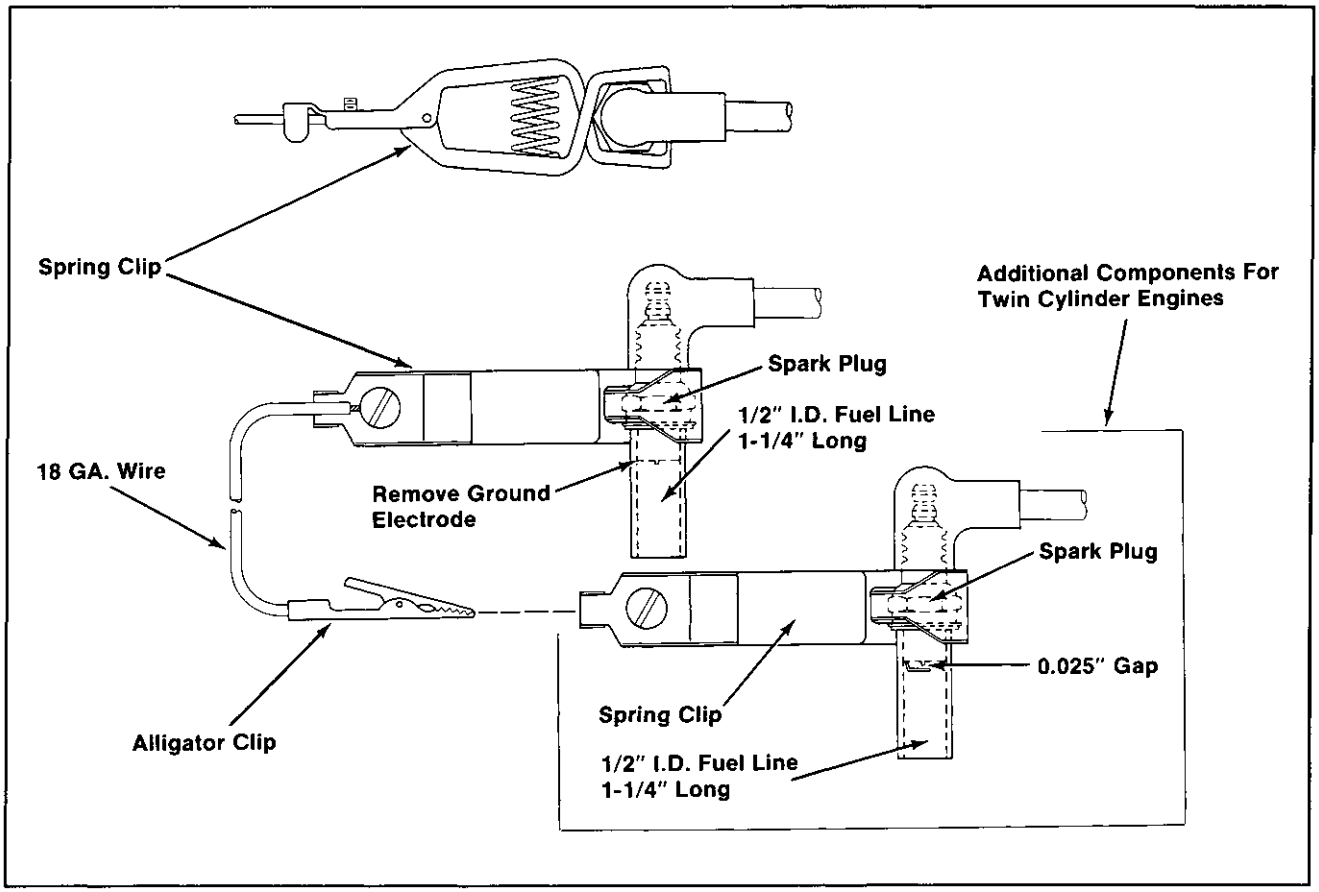


Figure 2-3. Electronic Ignition System Tester.

For Twin Cylinder Engines

(Models M18 and M20)

1. Obtain a new RJ-8 or RCJ-8 spark plug.
2. Remove the ground electrode from the spark plug. This gives a spark gap of 0.13". This large gap simulates the spark required under actual engine conditions.
3. Make a lead assembly using a large spring clip, an alligator clip, and 18 gauge wire as shown.
4. Cut a 1-1/4" length of 1/2" I.D. fuel line and slide it onto the threads of the test plug. The fuel line will shade the firing tip to make the spark more visible.
5. Obtain another new RJ-8 or RCJ-8 spark plug. Set the gap to **0.035"**.
6. 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.
7. 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.

RTV SILICONE SEALANT

RTV silicone sealant is used as a gasket between the crankcase, closure plate and cylinder barrels.

An easy-to-use **silicone sealant dispenser tube, Part No. 52 597 02**, is available. This dispenser tube contains 2.8 fl. oz. of RTV-108.

To order, contact your source of supply.

WATER MANOMETER

The Kohler Part No. 25 800 50 U-Tube water manometer is a useful tool to check crankcase vacuum (or pressure) and to check for exhaust back pressure. It can also be used to adjust primary regulators used with gaseous fuel systems. Complete instructions are provided in the kit.

CYLINDER LEAKDOWN TESTER

The Kohler Part No. 47 800 02 Cylinder Leakdown Tester is a valuable alternate to a compression test. By pressurizing the combustion chamber from an external air source, this tool can determine if valves or rings are leaking. Instruction for using this tester are found on page 4.4 of this manual.

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 Intervals" 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 before removing to keep dirt, grass clippings, etc., out of the engine.
3. Remove dipstick and wipe oil off. Reinsert dipstick and push it all the way down into tube. Remove 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.

SECTION 3
PERIODIC MAINTENANCE

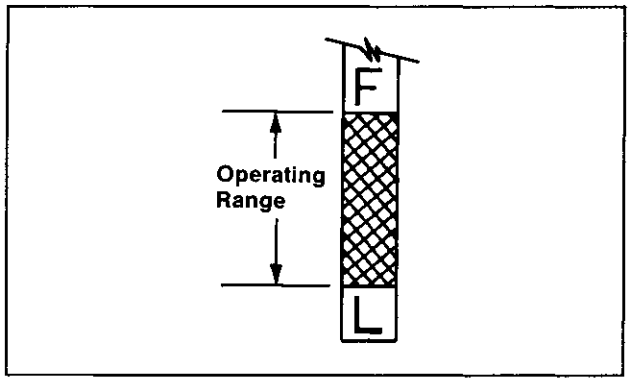


Figure 3-1. Oil Level Range.

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

   NOTE: 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.

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

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

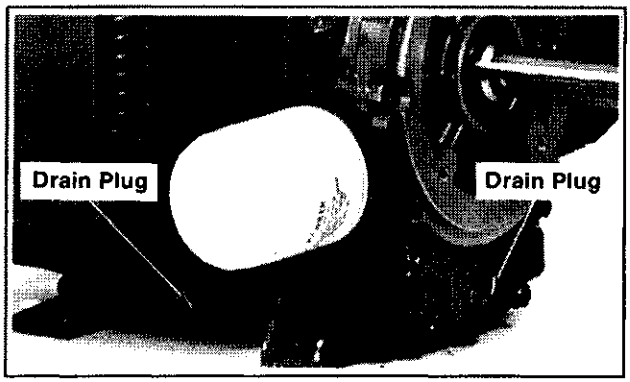


Figure 3-2. Oil Drain Plug Location.

OIL CHANGE INTERVALS

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

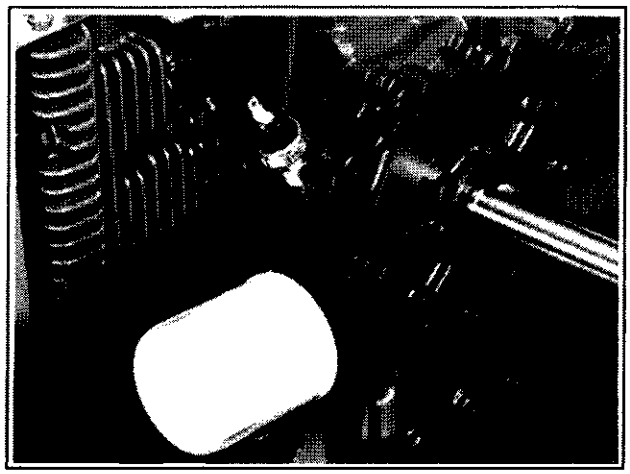


Figure 3-3. Oil Filter.

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 crankcase oil, then remove old filter.

2. Before installing replacement filter, apply a thin coating of oil on surface of the rubber seal.

3. Turn filter clockwise until rubber seal contacts the filter adapter, then tighten the filter an additional 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

Magnum 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 3-4.

Also refer to the "Air Cleaner" Section for disassembly and reassembly procedures for all styles of air cleaners used on these engines.

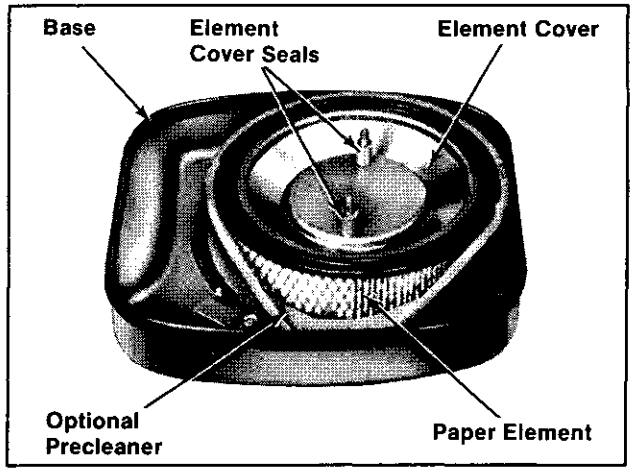


Figure 3-4. Air Cleaner Components.

Precleaner

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

1. Remove precleaner from paper element. Wash the precleaner in warm water with detergent.

2. Rinse precleaner thoroughly until all traces of detergent are eliminated. Squeeze out excess water (do not wring). Allow precleaner to air dry.

3. Saturate precleaner in clean, fresh engine oil. Squeeze out excess oil.

4. Reinstall precleaner over 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 seals, 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.

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

3. Install the precleaner (cleaned and oiled) over paper element.

4. Reinstall the paper element, element cover, and element cover seals.

5. Install air cleaner cover and wing nuts. Tighten wing nuts 1/2 to 1 full turn after nuts contact cover--do not overtighten.

Inspect Air Cleaner Components

Whenever the air cleaner cover is removed, or the element or precleaner 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 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.

NOTE: 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 3-5.

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.

NOTE: 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.

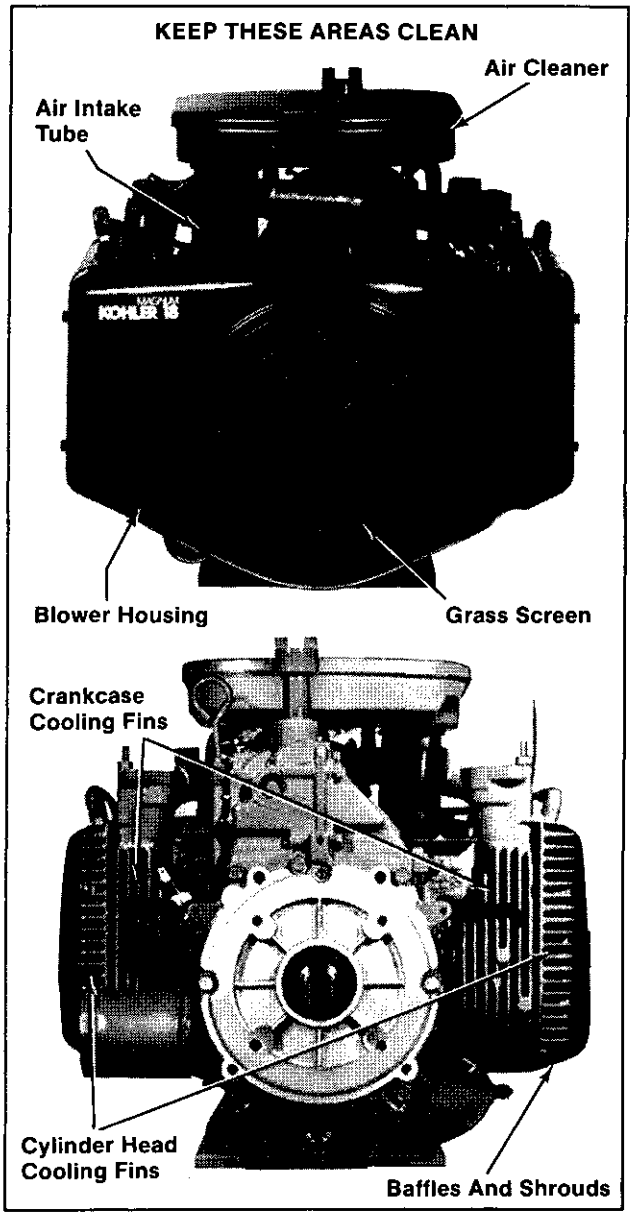


Figure 3-5. Air Intake and Cooling Areas.

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 3-6.

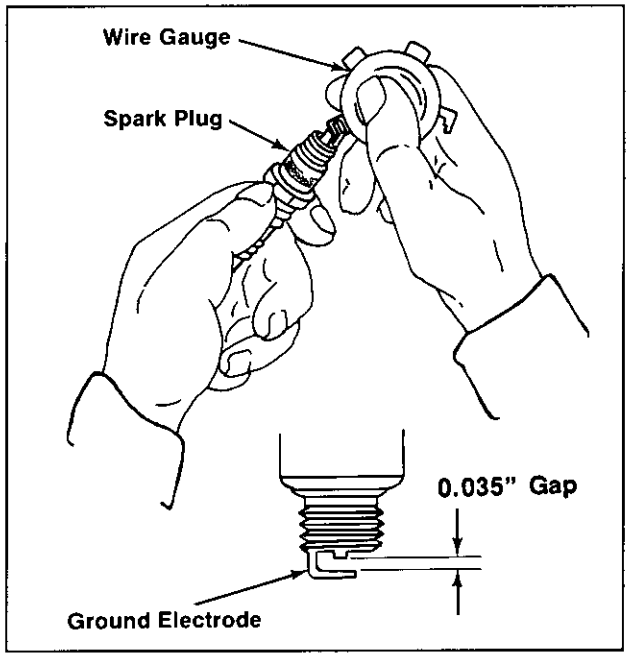


Figure 3-6. Servicing Spark Plugs.

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

2. Remove the plugs and check conditions. Replace the plugs if worn or if reuse is questionable.

   Use Champion® Type RV17YC or equivalent spark plugs.

   NOTE: 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.

3. Check gaps using a wire feeler gauge. Adjust gaps to **0.035"** by carefully bending the ground electrode.

4. Reinstall 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 necessary or possible with this system.

CHECK FUEL FILTER

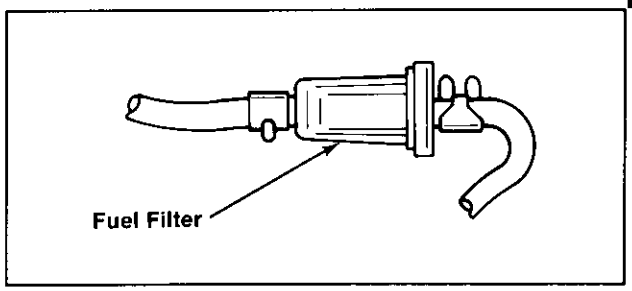


Figure 3-7. In-line Fuel Filter.

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 3-8.

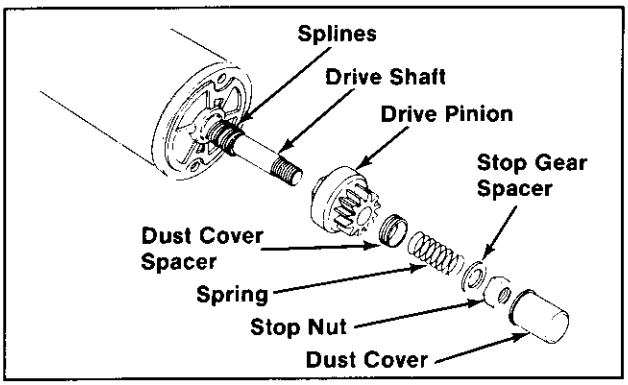


Figure 3-8. Starter Drive Components.

1. Remove starter from crankcase. (Refer to the "Disassembly" Section.)

2. Remove dust cover, stop nut, stop gear spacer, spring, dust cover spacer, and drive pinion.

3. Clean the drive shaft splines with solvent. Dry splines thoroughly.

4. Apply a small amount of Kohler electric starter drive lubricant (Part No. 52 357 01) to splines.

   NOTE: 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.

5. Apply a small amount of Loctite® No. 271 to stop nut threads. Assemble drive parts in reverse order of removal. Torque stop nut to **160 in. lb.**

6. Reinstall starter to crankcase.

CLEAN CYLINDER HEADS AND COMBUSTION CHAMBERS

Every 500 operating hours (250 hours when leaded gasoline is used), remove cylinder heads and clean combustion chambers. Refer to Figure 3-9.

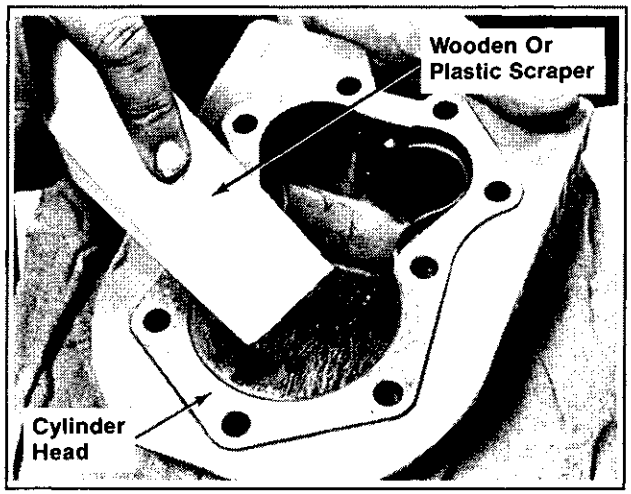


Figure 3-9. Cleaning Cylinder Heads and Combustion Chambers.

1. Remove cylinder head baffles and cylinder heads.

2. Clean away combustion deposits using a wooden or plastic scraper.

3. Reinstall cylinder heads using new gaskets. Torque cylinder head fasteners in increments to **15/20 ft. lb.** in the sequence specified in Figure 3-10.

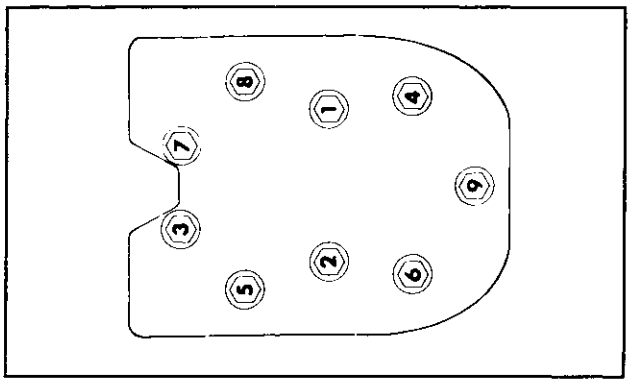


Figure 3-10. Cylinder Head Fastener Tightening Sequence.

CHECK VALVE-TO-TAPPET CLEARANCE

Every 500 operating hours, remove breather/valve covers and check valve-to-tappet clearance with a flat feeler gauge. Refer to Figure 3-11. The engine must be cold when checking this clearance.

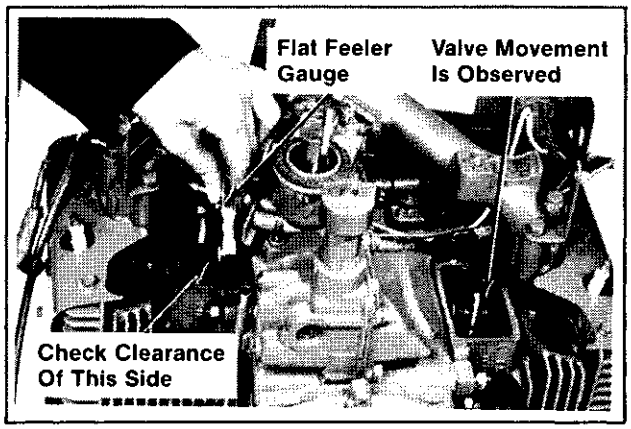


Figure 3-11. Measuring Valve-To-Tappet Clearance.

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

1. Disassemble air cleaner. Disconnect breather tube from air cleaner base. Remove base from air intake elbow and intake manifold.
2. Remove the valve cover and breather assembly 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 Valve (Closest to Flywheel)	**.003"/.006"**
Exhaust Valve (Serial No. 1816500646 and earlier) (Closest to PTO)	**.016"/.019"**
Exhaust Valve (Serial No. 1816500656 and later) (Closest to PTO)	**.011"/.014"**

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 3-11.
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 valve stems are ground perfectly flat and smooth.

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

   NOTE: Large clearance 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 spark plugs and torque to **10/15 ft. lb.**
2. Reinstall valve cover to #2 cylinder barrel. Reinstall breather assembly and valve cover to #1 cylinder barrel. Make sure breather is assembled correctly using new gaskets.
3. Reinstall air cleaner base to intake manifold and air intake elbow using new gasket.
4. Insert end of breather tube through hole in air cleaner base.

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

5. Reassemble remaining air cleaner components and tighten wing nut(s) 1/2 to 1 full turn after nut contacts cover. Do not overtighten.
6. Reconnect spark plug leads.

SECTION 3
PERIODIC MAINTENANCE

STORAGE

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

1. Clean the exterior surfaces of the engine.

2. Change the oil and filter while the engine is still warm from operation. See "Change Oil and Oil Filter."

3. 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.

4. Remove the spark plugs. Add one tablespoon of engine oil into each spark plug hole. Install plugs, but do not connect the plug leads. Crank the engine two or three revolutions.

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. Key switch or kill switch in "off" position.
6. Faulty spark plugs.
7. Faulty ignition module.
8. Dirt or water in the 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 key switch 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.
8. Stale fuel and/or gum in carburetor.

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.

SECTION 4
TROUBLESHOOTING

Engine Knocks

1. Low crankcase oil level.
2. Excessive engine load.
3. Old/improper fuel.
4. Internal wear or damage.

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/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.
6. Crankcase being overfilled.

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 seals on the air cleaner cover wing nuts. 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 under serviced.

☐ 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, over rich 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 into operation. Even small amounts of these cleaners quickly break down the lubricating properties of engine oil.

BASIC ENGINE TESTS

Crankcase Vacuum Test

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 water manometer. Kohler Part No. 25 800 50 is recommended. Complete instructions are provided in kit.

Test the crankcase vacuum with the manometer as follows:

1. Insert the stopper/hose into the oil fill hole. Leave the other vent of manometer open to atmosphere. Make sure the shut-off clamp is closed.
2. Start the engine and run at high speed (3200 to 3600 RPM).
3. Open the clamp and note the water level in the tube. The level in the engine side should be 13 to 20 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 shut-off 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 valves and sequences when necessary.
3. Piston blowby or leaky valves. (Confirm with compression or cylinder leakdown test.)	3. Recondition piston, rings, cylinder bores, valves, and valve guides.
4. Restricted exhaust.	4. Replace restricted muffler/exhaust system.