Onan
SERVICE BULLETIN
DIVISION OF ONAN CORPORATION
MINNEAPOLIS, MINNESOTA 55432

Eng.
7
3-73

GENERAL TORQUE INFORMATION

When servicing Onan equipment be sure to torque all nuts, bolts, and studs according to recommendations contained in this bulletin. Two factors to consider when discussing torque are:

1. EXCESSIVE FRICTION
2. CLAMPING FORCE

FRICTION is a force opposing motion. CLAMPING FORCE is a force that holds or fastens two or more things together.

NOTE: EXCESSIVE FRICTION CAN CAUSE DECREASING CLAMPING FORCE

Figure 1 shows a cap screw with excessive friction and no clamping force. Figure 2 shows a cap screw with good clamping force because of clean, lubricated threads.

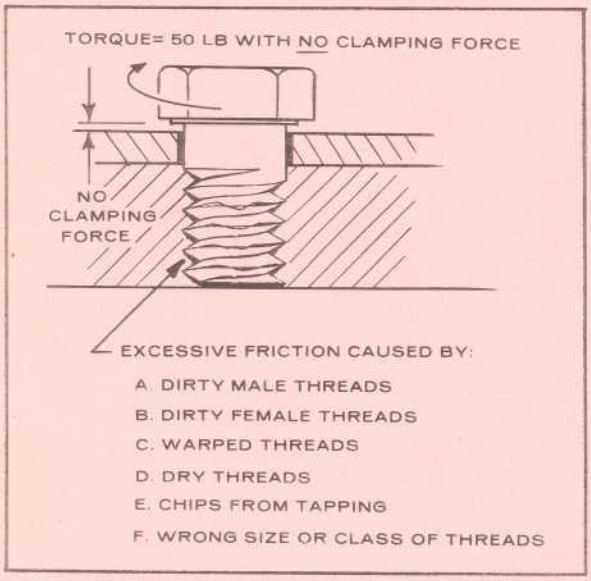


FIGURE 1. POOR CLAMPING FORCE

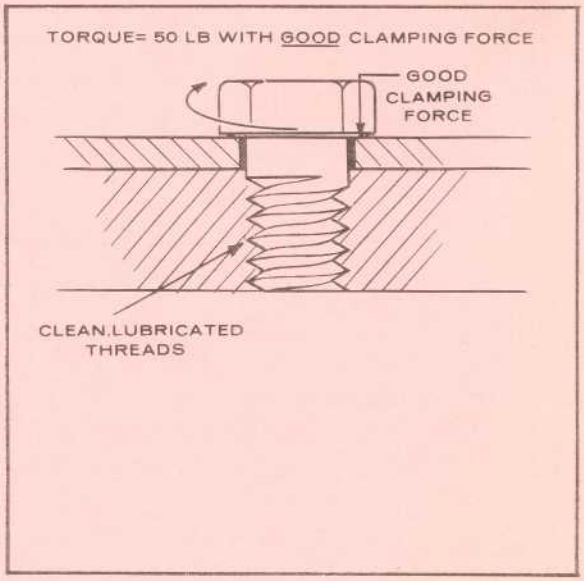


FIGURE 2. GOOD CLAMPING FORCE

TORQUE PROCEDURE

1. Clean all threads.
2. Lubricate threads with specified lubricant. (Assemble dry if specified).
3. Hand tighten all bolts.
4. Use the specified pattern (shown in Major Service Manual) for tightening sequence.
5. Tighten bolts to 1/2 the torque value.
6. Repeat pattern bringing all bolts up to full torque value. If no torque pattern is specified, start at centerline of gasket and torque bolts as shown in Figure 3, following numbered sequence.

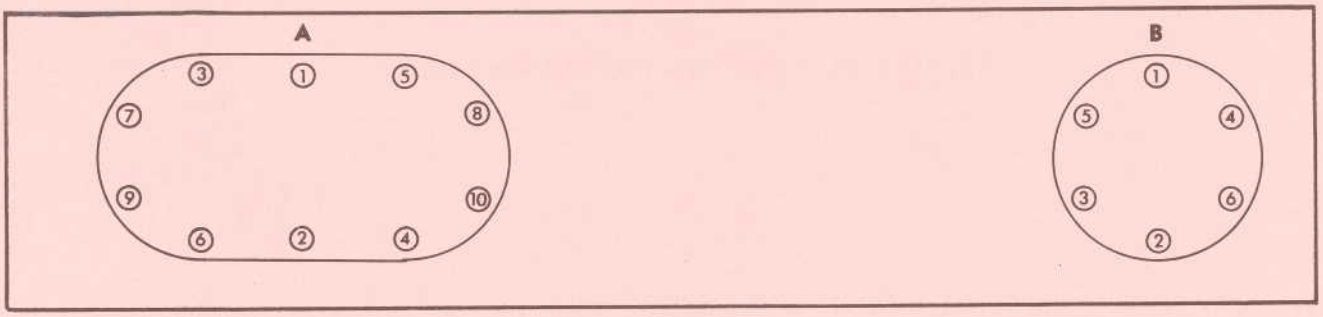


FIGURE 3. BASIC TORQUE PATTERN

TABLE 1. RECOMMENDED TORQUE IN FOOT-POUNDS

USE ENGINE LUBRICATING OIL AS A THREAD LUBRICANT						DO NOT USE ANY LUBRICANT ON THESE THREADS	
ENGINE SERIES	CYLINDER HEADS (COLD)	CONNECTING RODS	REAR BEARING PLATE	FLYWHEEL MOUNTING SCREW	OIL BASE	SPARK PLUGS	ARMATURE THRU STUD
AJ,MAJ	24-26	10-12	20-25	35-40	25-30	25-30	25-30
AK	24-26	10-12	20-25	35-40	25-30	25-30	25-30
LK,LKB	29-31	26-28	20-25	35-40	25-30	25-30	35-40
CCK,CCKB	29-31	*	20-25	35-40	43-48	25-30	35-40
NB	29-31	*	30-35	***30-35	38-43	15-20	35-40
NH	22-25	27-29	25-27	***30-35	18-23	15-20	35-40
NHA,B,C	8-20	27-29	20-23	35-40	18-23	15-20	35-40
BF	14-16	14-16	25-27	35-40	18-23	15-20	45-50
CCKA	29-30	**	20-25	35-40	43-38	25-30	35-40

* NB Aluminum Rods 24-26 #, Forged Rods 27-29 #
** CCK, CCKA and CCKB Forged Rods 27-29 #, Aluminum Rods 24-26 #
*** Zinc or Alum. Wheel 30-35, Cast Iron Wheel 40-45

CAUTION *Cylinder head bolts on "J" series water-cooled units that have been overhauled must be retorqued after 1/2 hour to 2 hours of operation. (Not necessary on new units from factory.) Cylinder head bolts on "J" series air-cooled units must be retorqued to specified torque value after 50 hours of operation. (Back off 1/2 turn and then retighten.)*

TABLE 2. RECOMMENDED TORQUE IN FOOT-POUNDS

USE ENGINE LUBRICATING OIL AS A THREAD LUBRICANT											DO NOT USE ANY LUBRICANT ON THESE THREADS			
											ARMATURE THROUGH STUD			
ENGINE SERIES	CYL. HEAD (COLD)	CONN. ROD	REAR BRG. PLATE	MAIN BRG. (4 CYL.)	FLYWHEEL TO CRANKSHAFT	OIL BASE	EXHAUST MANIFOLD (Tighten Evenly)	INTAKE MANIFOLD	DAMPER FLYWHEEL ASSY. NUT (4 CYL.)	ROCKER ARM STUD IN HEAD	REVOLVING ARM. UNITS	REVOLVING FIELD UNITS	SPARK PLUGS	INJECTION NOZZLE
JA	28-30	27-29	40-45		65-70	32-38	13-15	13-15		25-30	30-40		25-30	
JB	28-30	27-29	40-45		65-70	45-50	13-15	13-15		25-30		55-60	25-30	
JC	28-30	27-29	40-45	97-102	65-70	45-50	13-15	13-15		25-30		55-60	25-30	
MJA	44-46	27-29	40-45		65-70	32-38	13-15	13-15		35-40	30-40		25-30	
MJB	44-46	27-29	40-45		65-70	45-50	13-15	13-15		35-40		55-60	25-30	
MJC	44-46	27-29	40-45	97-102	65-70	45-50	13-15	13-15	17-21	35-40		55-60		20-21
MDJA	44-46	27-29	40-45		65-70	32-38	13-15	13-15		35-40	30-40			20-21
DJA *	44-46	27-29	40-45		65-70	32-38	13-15	13-15		35-40	30-40			20-21
MDJB	44-46	27-29	40-45		65-70	45-50	13-15	13-15		35-40		55-60		20-21
DJB *	44-46	27-29	40-45		65-70	45-50	13-15	13-15		35-40		55-60		20-21
MDJE	44-46	27-29	40-45		65-70	45-50	13-15	13-15		35-40		55-60		20-21
MDJC	44-46	27-29	40-45	97-102	65-70	45-50	13-15	13-15	17-21	35-40		55-60		20-21
DJC *	44-46	27-29	40-45	97-102	65-70	45-50	13-15	13-15	17-21	35-40		55-60		20-21
MDJF	44-46	27-29	40-45	97-102	65-70	45-50	13-15	13-15	17-21	35-40		55-60		20-21
RJC	44-46	27-29	40-45	97-102	65-70	45-50	13-15	13-15	17-21	35-40		55-60	25-30	
RDJC	44-46	27-29	40-45	97-102	65-70	45-50	13-15	13-15	17-21	35-40		55-60		20-21
RDJF	44-46	27-29	40-45	97-102	65-70	45-50	13-15	13-15	17-21	35-40		55-60		20-21

* - NOTE: Use Never-Seeze in Torqueing to this value.

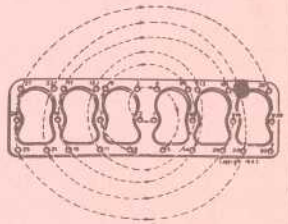
International TORQUE SPECIFICATIONS FOR ALL BOLTS

METRIC STANDARD

GRADE OF BOLT		5D	8G	10K	12K		
MIN. TENSILE STRENGTH		71,160 P.S.I.	113,800 P.S.I.	142,200 P.S.I.	170,679 P.S.I.		
GRADE MARKINGS ON HEAD		5D	8G	10K	12K	SOCKET OR WRENCH SIZE	
METRIC		TORQUE (IN FOOT POUNDS)				METRIC	
BOLT DIA.	U.S. DEC. EQUIV.					BOLT HEAD	NUT
6mm	.2362	5	6	8	10	10mm	10mm
8mm	.3150	10	16	22	27	14mm	14mm
10mm	.3937	19	31	40	49	17mm	17mm
12mm	.4720	34	54	70	86	19mm	19mm
14mm	.5512	55	89	117	137	22mm	22mm
16mm	.6299	83	132	175	208	24mm	24mm
18mm	.709	111	182	236	283	27mm	27mm
22mm	.8661	182	284	394	464	32mm	32mm
24mm	.945	261	419	570	689	36mm	36mm

RECOMMENDED SEQUENCE FOR TIGHTENING CYLINDER HEAD BOLTS

(1) Tighten all bolts to 1/3 final full Torque.
(2) Re-tighten all bolts to 2/3 final Torque.
(3) Re-tighten all bolts to full Torque and proper sequence.
(4) Re-tighten to full Torque again in reverse sequence. (This insures that no bolts have been missed.)
(5) Re-Torque to final specifications in normal sequence again after engine warm up.



U.S. STANDARD

GRADE OF BOLT		SAE 1 & 2	SAE 5	SAE 6	SAE 8		
MIN. TENSILE STRENGTH		64,000 P.S.I.	105,000 P.S.I.	133,000 P.S.I.	150,000 P.S.I.		
GRADE MARKINGS ON HEAD						SOCKET OR WRENCH SIZE	
U.S. STANDARD		TORQUE (IN FOOT POUNDS)				U.S. REGULAR	
BOLT DIA.	U.S. DEC. EQUIV.					BOLT HEAD	NUT
1/4	.250	5	7	10	10.5	3/8	7/16
5/16	.3125	9	14	19	22	1/2	9/16
3/8	.375	15	25	34	37	9/16	5/8
7/16	.4375	24	40	55	60	5/8	3/4
1/2	.500	37	60	85	92	3/4	13/16
9/16	.5625	53	88	120	132	7/8	7/8
5/8	.625	74	120	167	180	15/16	1.
3/4	.750	120	200	280	296	1-1/8	1-1/8
7/8	.875	190	302	440	473	1-5/16	1-5/16
1.	1.000	282	466	660	714	1-1/2	1-1/2

MULTIPLY READINGS BY 12 FOR INCH POUND VALUES

WHEN USING CHART:

1. Use FEL-PRO C5A compound or other high stress lubricant under the bolt head as well as on the threads. (Use torque-figures directly.)
2. Increase torque by 20% if engine oil or grease is used as lubricant. (Don't torque bolts dry.) (Follow manufacturers specific specs if available.)
3. Reduce torque by 20% when new Cadmium plated bolts are used.

CAUTION

Bolts threaded into aluminum may require much less torque.

WHITWORTH STANDARD

GRADE OF BOLT		A & B	S	T	V		
MIN. TENSILE STRENGTH		62,720 P.S.I.	112,000 P.S.I.	123,200 P.S.I.	145,600 P.S.I.		
GRADE MARKINGS ON HEAD			S	T	V	SOCKET OR WRENCH SIZE	
WHITWORTH		TORQUE (IN FOOT POUNDS)				WHITWORTH	
BOLT DIA.	U.S. DEC. EQUIV.					BOLT HEAD	NUT
1/4	.250	5	7	9	10	*1/4	*1/4
5/16	.3125	9	15	18	21	*5/16	*5/16
3/8	.375	15	27	31	36	*3/8	*3/8
7/16	.4375	24	43	51	58	*7/16	*7/16
1/2	.500	36	64	79	89	*1/2	*1/2
9/16	.5625	52	94	111	128	*9/16	*9/16
5/8	.625	73	128	155	175	*5/8	*5/8
3/4	.750	118	213	259	287	*3/4	*3/4
7/8	.875	186	322	407	459	*7/8	*7/8
1.	1.000	276	497	611	693	*1.	*1.

*Dimensions given on handles of U.S. wrenches refer to actual size of bolt head or nut. Dimension given on Whitworth wrenches refer to the shank or body diameter of the bolt, NOT THE BOLT HEAD OR NUT SIZE.

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ENGINE CRANKCASE OIL RECOMMENDATIONS FOR ONAN EQUIPMENT

2-73

LUBRICATING OIL SELECTION

Lubricating oils for spark-ignited and diesel engines are made in a variety of service classifications, each in several viscosities. Selection of an oil for a particular engine, considering its fuel and operating conditions, is based on these classifications.

OIL CLASSIFICATION

The classification of oil required depends on the kind of engine, the operating conditions, and the fuel (gaseous fueled engines may require special ash content detergent oils). A new system, jointly developed by the American Petroleum Institute (API), the Society of Automotive Engineers (SAE), and the American Society for Testing and Materials (ASTM) is now used to identify the classifications. A new classification - SE - has been added to cover oils with very high resistance to oil oxidation (or oil thickening) caused by high oil temperatures.

VISCOSITY

Viscosity is a measurement of resistance to flow. For oil, this resistance is affected by temperature. Multiple grade oils are made to provide starting capability when the oil is cold and also to provide engine protection at operating temperatures. Viscosity identification is by SAE number. SAE 30 oil has a viscosity which is specified and measured at 210° F. SAE 10W oil has a viscosity which is specified and measured at 0° F (the suffix W indicates a 0° F specification). Multigrade oils (such as 5W-30) must meet viscosity specifications at both 0° F and 210° F.

RECOMMENDED CLASSIFICATIONS AND VISCOSITIES

The API/SAE/ASTM classifications and SAE viscosities for ONAN equipment are given in Table I. The new SE classification has not been mentioned in previous ONAN publications. The oil recommendations listed herein for ONAN built engines supersede those given in previous ONAN publications. For ashless - ashless dispersant type oil or high ash oils, see Engine Manufacturer's Association (EMA) Form 1-12/70 (or later) columns "Natural Gas/LPG-Lo Ash" or "Natural Gas/LPG-Hi Ash" respectively and "Ash Content (Sulfated) % by Weight". If natural gas engine oil is not available, use MIL-L-2104A (S-1) oils.

TABLE I - OIL RECOMMENDATIONS

ENGINE	SERV CLASS (by FUEL)	STARTING TEMP (F) AND VISCOSITY (SAE)				
AJ, AK, BF, CCK	gasoline-SE,SE/CC gaseous [1]	TEMP	Below 0°	0° to 32°	32° to 90°	Above 90
		VISC	5W-30	10W-30, 5W-30	30	50
CCKA	gasoline-SE, SE/CC gaseous [1]	TEMP	Below 0°	0° to 32°	32° to 90°	Above 90
		VISC	5W,5W-20	10W	30	50
CCKB	gasoline-SE,SE/CC gaseous [1]	TEMP	Below 0°	0° to 32°	32° to 90°	Above 90
		VISC	5W-30	10W-30, 5W-30	30	50
DEF, DEG, DEH	CD, SE/CD	TEMP	Below -10°	-10° to 40°	40° to 70°	70° to 100
		VISC	5W-30	10W	20	30
DFP, DFM, DFT, DFU, DFV, DFW	CC/CD, SE/CD,	TEMP	-10° to 32°	32° to 90°	Above 90°	
		VISC	10W	20	30	
DJA, DJB, DJBA, DJC	CD/SE, CD/SD CC/SD [2], CC/SE [2]	TEMP	Below 0°	0° to 32°	Above 32°	
		VISC	5W-20 or 5W-30	5W-20, 10W, 10W-30 or 5W-30	30	
DLA	CD, SE/CD	TEMP	Below 32°	32° to 85°	Above 85°	
		VISC	10W	20/20W	30	
DYA, DYB, DYC, DYD, DYG	CD/SE, SE/CD	TEMP	Below 0°	0° to 32°	Above 32°	
		VISC	10W	10W-30, 5W-30	30	
EK, EM	gasoline-SE,SE/CC gaseous-SD/CC	TEMP	Below -10°	-10° to 32°	32° to 100°	Above 100
		VISC	5W-30, 10W-40	20	30	40
FT	CC [3]	TEMP	-10° to 32°	32° to 90°	Above 90°	
		VISC	10W	20	30	
JB, JC	gasoline-SE,SE/CC gaseous [1]	TEMP	Below 32°	Above 32°		
		VISC	5W-20 or 5W-30	30		
KB, KR	gasoline-SE,SE/CC gaseous - SD/CC	TEMP	Below 32°	Above 32°		
		VISC	10W	30		
LK, LKB, MAJ, MCCK	gasoline-SE,SE/CC gaseous [1]	TEMP	Below -0°	0° to 32°	32° to 90°	Above 90°
		VISC	5W-30	10W-40, 5W-30	30	50
MDEG, MDEH	CD,SE/CD	TEMP	Below -10°	-10° to 40°	40° to 70°	70° to 100
		VISC	5W-30	10W	20	30

MDJA, MDJB, MDJC MDJE, MDJF	CD/SE, CD/SD, CC/SE [2], CC/SD [2]	TEMP VISC	Below 0° 5W-20 or 5W-30	0° to 32° 5W-20, 10W-30 10W,5W-30	Above 32° 30	
MJC	SE, SE/CC	TEMP VISC	Below 32° 5W-20 or 5W-30	Above 32° 30		
NB, NH, NHA, NHB, NHC	gasoline-SE, SE/CC gaseous [1]	TEMP VISC	Below 0° 5W-30	0° to 32° 10W-40, 5W-30	32° to 90° 30	Above 90 50
PC	gasoline-SE, SE/CC gaseous-SD/CC	TEMP VISC	Below 40° 5W-30	Above 40° 30		
RDJC, RDJF	CD/SE, CD/SD, CC/SE [2], CC/SD [2]	TEMP VISC	Below 0° 5W-20 or 5W-30	0° to 32° 5W-20, 10W-30, 10W,5W-30	Above 32° 30	
RJC	gasoline-SE, SE/CC gaseous [1]	TEMP VISC	Below 32° 5W-20 or 5W-30	Above 32° 30		
TD, TE, TF	SE, SE/CC	TEMP VISC	Below 32° 10W	Above 32° 30		
		OIL OPERATING TEMPERATURE (F) AND VISCOSITY (SAE)				
WA	any fuel - SE, SE/CC	TEMP VISC	130°-155° 20W	155°-190° 30	190°-230° 40	
WB, WC	gasoline-SE, SE/CC gaseous [4]	TEMP VISC	140°-160° 20W	160°-180° 30	180°-200° 40	200°-220 50
WE	gasoline-SE, SE/CC gaseous - see page1	TEMP VISC	130°-155° 20	155°-190° 30	190°-230° 40	
WF, WK	[4]	TEMP VISC	150°-200° 30	200°-230° 40		

[1] Ashless or low-ash detergent oils specifically made for gaseous-fueled engines are also approved for LPG (butane, propane) or natural gas fuels.

[2] CC oils are acceptable only for ambient temp. below 32° F or during break-in.

[3] Oil with 0.03 to 0.85 percent by weight sulfated ash.

[4] Oil made for gaseous-fueled engines and containing 5000 PPM of barium, calcium, or both together with 0.03 percent by weight zinc. Also has sulfated ash level of 2.0 to 3.4 percent by weight. Lower ash oils may perform satisfactorily but high ash oils improve seat wear.

BASIS FOR RECOMMENDATIONS

The recommendations made in Table I are based upon knowledge required, the API/SAE/ASTM classifications, and shop testing. The classifications define the best oil for each operating condition as described in Table II.

TABLE II CLASSIFICATIONS AND OPERATING CONDITIONS

API/SAE/ASTM DESIGNATIONS NEW	OLD	SERVICE AND OIL DESCRIPTIONS
SA	ML	*Utility Gasoline Engine Service* Mildest operating conditions. No performance requirements. No additives except perhaps pour and/or foam depressants.
SB	MM	*Minimum Duty Gasoline Engine Service* Conditions so mild that only minimum compounding is required. Oil has some resistance to oil oxidation and bearing corrosion - also some antiscuff qualities.
SC	1964-1967 MS	*1964 Gasoline Engine Warranty Service* 1964 through 1967 automobile manufacturer gasoline engine operating conditions. Oil designed to control high and low temperature deposits, wear, and corrosion.
SD	1968-1971 MS	*1968 Gasoline Engine Warranty Service* 1968 automobile manufacturers gasoline engine operating conditions. Performance better than that of SC oils and may be used in their stead.
SE	--	*ASTM Engine Test Sequence* Oil designed to meet the 1972 requirements of the automobile manufacturers and to stand up under high operating temperatures caused by today's high speeds and heavy loads. Contains greater quantities of anti-oxidants which keep oil from turning into molasses-like sludge. Safeguards against bearing failure and total engine breakdown.
CA	DG	*Light Duty Diesel Engine Service* Oils intended for service in light to moderate duty normally aspirated diesel engines using high quality low sulfur fuel. Meets MIL-L-2104A (1954)
CB	DG	*Moderate Duty Diesel Engine Service* These oils are similar to CA oils except that they are capable of providing the protection when high sulfur fuels are used.
CC	DM	*Moderate Duty Diesel and Gasoline Engine Service* Oils meeting requirements of MIL-L-2104B (1964). Provides low temperature anti-sludge and anti-rust performance in lightly supercharged diesel engines.
CD	DS *(Series 3)*	*Severe Duty Diesel Engine Service* These oils are for service typical of supercharged diesel engines in high speed, high output duty requiring very effective wear/deposit control. Provide protection versus bearing corrosion and high temperature deposit formation in supercharged diesel units using wide quality range fuels. CD oils meet the Caterpillar Tractor Co. Series 3 Specification.

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GASOLINE FUEL

LEADED VS NONLEADED

Most gasoline contains some lead additives (Tetraethyl lead) which accumulate in engine combustion chambers.

Since generator sets operate at constant (governor-controlled) speeds, it is difficult for the engine to "blow out" these lead deposits through the exhaust ports as is possible with engines operating at variable speeds. Therefore constant speed engines may require more frequent removal of deposits and more maintenance.

For this reason, Onan recommends the use of low-lead and nonleaded gasoline. Onan has run several conclusive tests with leaded vs nonleaded gasoline on various governor controlled engines. We find that using nonleaded gasoline helps reduce problems such as:

Cylinder Head Deposits (low power)
Sticking Valves or Burned Valves
Spark Plug Fouling
Piston Wear
Ring Wear and Sticking
Cylinder Wall Wear, etc.
Poor Oil Control After Ring Fouling

For new Onan engines, we recommend using nonleaded gasoline from the start. On older engines, if you desire to change from leaded gasoline to nonleaded, the engine head must be taken off and all lead deposits removed from the engine.

CAUTION *If lead deposits are not removed from the engine before switching from leaded to nonleaded gasoline, preignition could occur causing severe damage to the engine.*

NOTE: The information in this bulletin on the use of lead free or low lead gasoline pertains to Onan-built engines ONLY. For Onan generator sets of all sizes having Ford, International, Waukesha, Tecumseh, or Briggs and Stratton engines, consult the engine manufacturers owner's manual accompanying the unit for specific fuel recommendations. This is a separate manual from the Onan Operator's manual which also comes with each unit.

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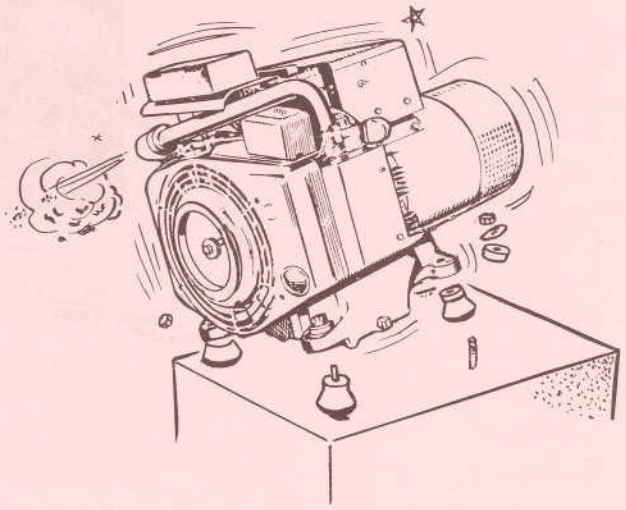
ONAN TWO-CYLINDER OPPOSED ENGINE FIRING ON ONE CYLINDER

ONAN two-cylinder opposed engines (BF-CCK-NH) will run fairly well when firing on 1 cylinder, if no load or a minimum load is applied. However, loss of power is quickly noticed when a full load is put on the engine. If this should occur, check the following in this order:



1. Fuel Flow
2. Ignition
3. Compression

FUEL FLOW

A lean fuel mixture is the major cause of a two-cylinder opposed engine firing on only 1 cylinder. A lean mixture usually results from an improperly adjusted main fuel adjustment screw on the carburetor.

With the engine running, gradually turn the main fuel adjustment screw counterclockwise until the cylinder begins to fire. If, after two complete turns, the cylinder fails to fire, return the adjustment screw to its original position.

Check the intake manifold and connections for leaks. If uncertain, apply oil to the manifold gaskets (without disassembling) while the unit is running. Subsequent smoking or an increase in RPM indicates a leak. Repair or replace as required.

IGNITION

Check the ignition system even if the spark plugs seem to be working:

- Check the breaker points for correct gap.
- Check for a sticking breaker plunger.
- Check spark plugs for fouling, cracked insulation and the correct gap.

- Check spark plug wires for loose connections and possible shorts.
- Check the coil for continuity and shorts. Test the primary and secondary windings as follows:

1. Use a volt/ohm/ammeter or equivalent.
2. Place black lead on ground(-) terminal of coil and red lead to positive (+) terminal. Primary resistance should read 0.50 to 4.73 ohms.
3. Change resistance setting on meter. Place meter leads inside of spark plug cable holes (Figure 1). Secondary resistance should read 10,800 to 15,400 ohms.

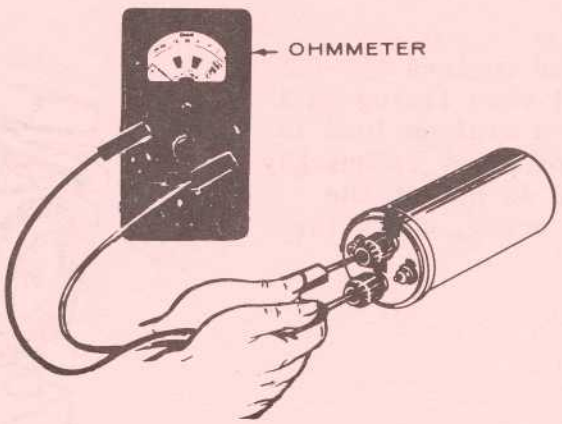


FIGURE 1. TESTING IGNITION COIL

COMPRESSION

Low compression can also cause a "dead" cylinder. Any one of the following will lower compression. Check and repair or replace as necessary:

1. Incorrect valve clearance.
2. Broken valve spring.
3. Warped or burned valve and/or valve seats.
4. Worn or broken piston rings.
5. Blown head gasket.