POWER SOLUTIONS INTERNATIONAL

4.5L, 6.7L, 10L, & 13L OPERATIONS & MAINTENANCE MANUAL

POWER SYSTEMS

PSI POWER SYSTEMS

7610061-3 10/01

A Product by Power Solutions International

Wood Dale, IL

Power Solutions International, Inc (PSI)

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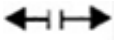
630-350-9400

REVISION CONTROL INFORMATION

Revision Level	Release Date	Change Description (s)
1	1/02/2024	Initial Release
2	5/8/2024	Updated Oil Capacity in tables
3	10/01/2024	Updated Engine Maintenance Guidelines

Table of Contents

Description of the Illustration Marks

	Dismounting (assembly parts)		Oil Coating
	Fitting (assembly parts)		Special Tools
	Marking (do before disassembling, adjust when assemble)		Pay attention to assembly direction
	Filling – full charge (such as lubricating oil, cooling water, etc.)		Deflating
	Draining off (lubricating oil or cooling water)		Unloosing (such as: unloose clamping equipment)
	(Loose-proof-fixed) – Coat fluid sealant		Clamping (such as: reinforcing clamp equipment)
	Accident preventing (marks for dangerous occasion)		Inspecting – adjusting (such as: tightening torque, dimension pressure and clearance)
	Replacement during re-assembly		Inspecting

NOTE

This manual only applies only to black/PSI rebranded engine specs as listed in the attached engine matrix.

	Spec Numbers
	Description
4.5L	G-Drive, 4.5L Energy Cert G-Drive, 4.5L Energy Non-Cert G-Drive, 4.5L Industrial Cert G-Drive, 6.7L Industrial Non-Cert
6.7L	G-Drive, 6.7LT Energy Cert G-Drive, 6.7LT Energy Non-Cert G-Drive, 6.7L Industrial Cert G-Drive, 6.7L Industrial Non-Cert
6.7LT	G-Drive, 6.7LT Energy Cert G-Drive, 6.7LT Energy Non-Cert G-Drive, 6.7LT Industrial Cert G-Drive, 6.7LT Energy Non-Cert
10L	G-Drive, 10L Energy Cert G-Drive, 10L Energy Non-Cert G-Drive, 10L Industrial Cert G-Drive, 10L Industrial Non-Cert
10LT	G-Drive, 10LT Energy Cert G-Drive, 10LT Energy Non-Cert G-Drive, 10LT Industrial Cert G-Drive, 10LT Industrial Non-Cert
13LT	OBSOLETE
13LTHO	G-Drive, 13LTHO Energy Cert G-Drive, 13LTHO Energy Non-Cert G-Drive, 13LTHO Industrial Cert G-Drive, 13LTHO Industrial Non-Cert

Engine Introduction and Performance Parameters

Engine Main Performance Parameters – 4.5L

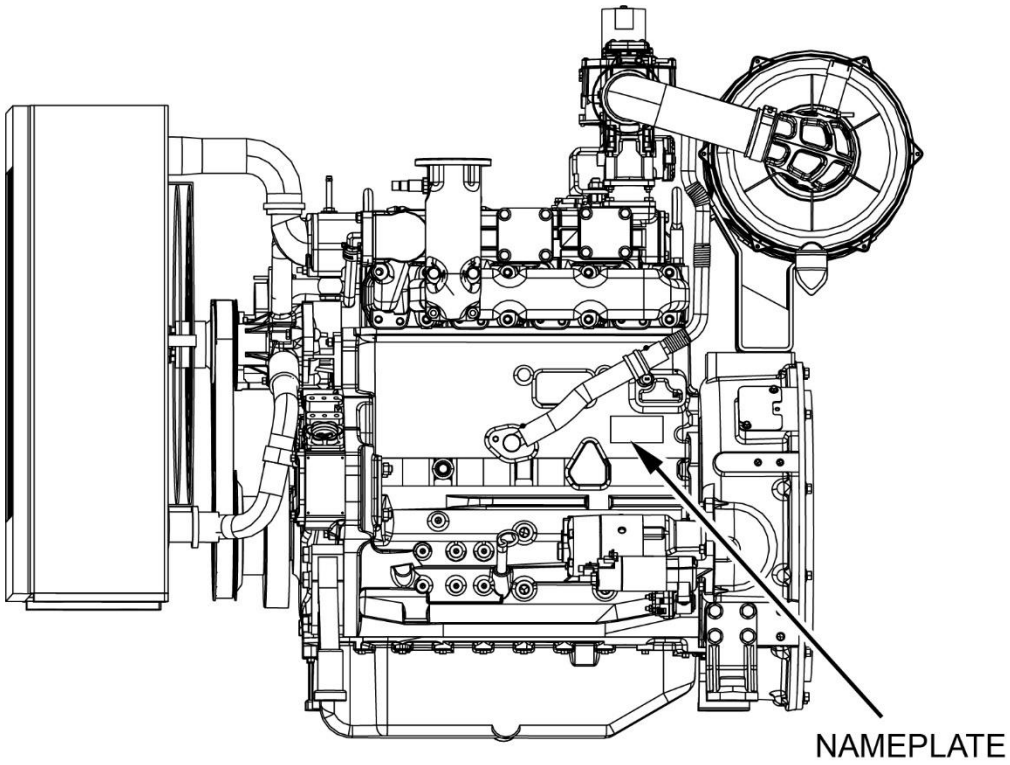


Illustration 1- Engine nameplate

See engine nameplate to find engine model, series number, rated power, rated speed and weight.

More data as following table:

4.5L Gas Engine Data

Item		Unit	Content
Engine type			4.5L naturally aspirated
Number of cylinders			4
Displacement		L	4.5
Cylinder bore * stroke		mm	105 * 130
Compression ratio			9.75:1
Idle speed		rpm	1000
Fire order			1-3-4-2
Rotation			CCW viewed on flywheel
Oil pressure	Idle speed	KPA	≥120
	Rated speed	KPA	300~550
Oil temperature range (under rated condition)		℃	85~105
Oil capacity		L	9~12
Engine coolant capacity		L	Engine: 5.3L; engine and radiator: 16.3L
Intake valve lash (cold)		mm	0.2
Exhaust valve lash (cold)		mm	0.4
Spark plug gap		mm	0.3~0.35
Allow to tilt	Front / back	°	10/10
	Right / left	°	10/10
Dry Weight		kg	500
Size (with radiator and air filter) (L*W*H)		mm	1433*774*1097

Note: Oil Viscosity should be determined based on Ambient Temperature Operations.

Engine Main Performance Parameters – 6.7L

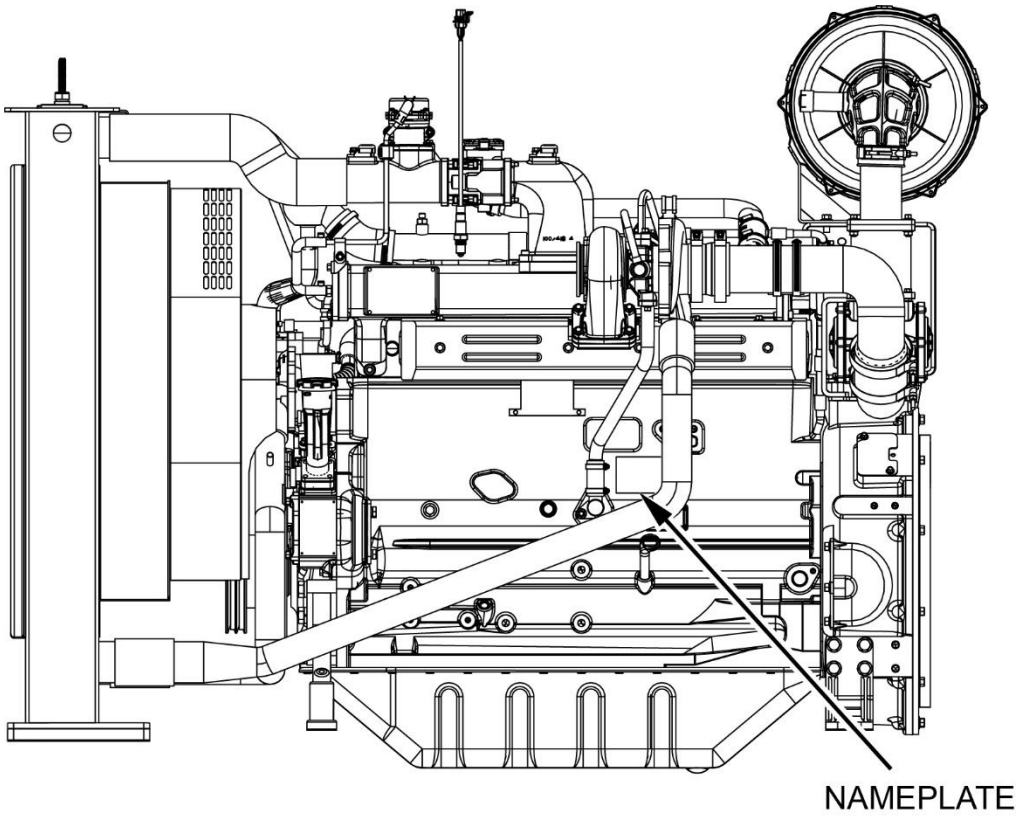


Illustration 2- Engine nameplate

See engine nameplate to find engine model, series number, rated power, rated speed and weight.

More data as following table:

6.7L Gas Engine Data

Item		Unit	Content	
Engine type			6.7L naturally aspirated	6.7L turbocharged
Number of cylinders			6	
Displacement		L	6.75	
Cylinder bore * stroke		mm	105 * 130	
Compression ratio			9.75:1	
Idle speed		rpm	1000	
Fire order			1-5-3-6-2-4	
Rotation			CCW viewed on flywheel	
Oil pressure	Idle speed	KPA	⩾120	
	Rated speed	KPA	300~600	
Oil temperature range (under rated condition)		℃	85~105	85~105
Oil capacity		L	24~27	
Engine coolant capacity		L	8	
Intake valve lash (cold)		mm	0.2	
Exhaust valve lash (cold)		mm	0.4	
Spark plug gap		mm	0.3~0.35	0.45
Allow to tilt	Front / back	°	10/10	
	Right / left	°	10/10	
Dry Weight		kg	575±50	625±50
Size (with radiator and air filter) (L*W*H)		mm	1760*840*1156	1677*830*1167

Note: Oil Viscosity should be determined based on Ambient Temperature Operations.

Engine Main Performance Parameters – 10L

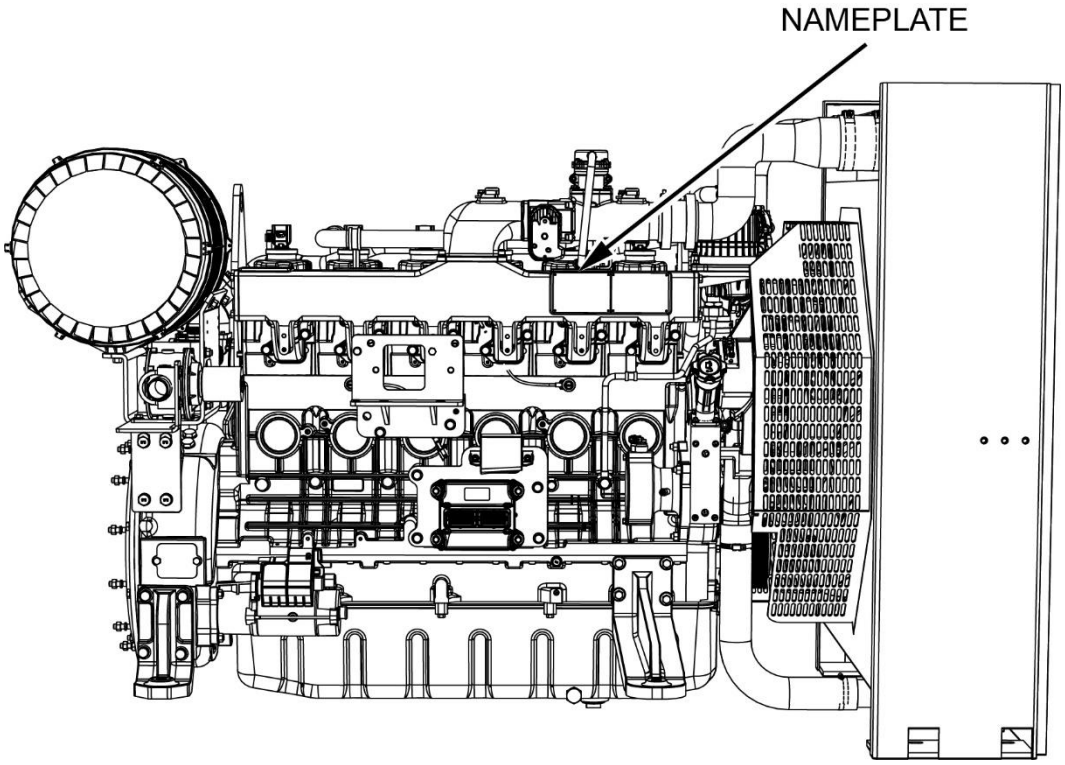


Illustration 3- Engine nameplate

See engine nameplate to find engine model, series number, rated power, rated speed and weight.

More data as following table:

10L Gas Engine Data

Item		Unit	Content	
Engine type			10L natural aspirated	10L turbocharged
Number of cylinders			6	
Displacement		L	9.726	
Cylinder bore * stroke		mm	126 * 130	
Compression ratio			9.75	10.5
Idle speed		rpm	1000	
Fire order			1-5-3-6-2-4	
Rotation			CCW viewed on flywheel	
Oil pressure	Idle speed	KPa	≥130	
	Rated speed	kPa	350~580	
Oil temperature range (under rated condition)		℃	85~105	
Oil capacity		L	24~30	
Engine coolant capacity		L	22	
Exhaust temperature		℃	≤790	≤760
Intake valve lash (cold)		mm	0.5	
Exhaust valve lash (cold)		mm	0.8	
Spark plug gap		mm	0.45	
Allow to tilt	Front / rear	°	5	
	Air intake side / exhaust side	°	5	
Dry Weight		kg	970	1000
Size (with radiator and air filter) (L*W*H)		mm	1725x960x1170	1725×945×1175

Note: Oil Viscosity should be determined based on Ambient Temperature Operations

Engine Main Performance Parameters – 13LTHO

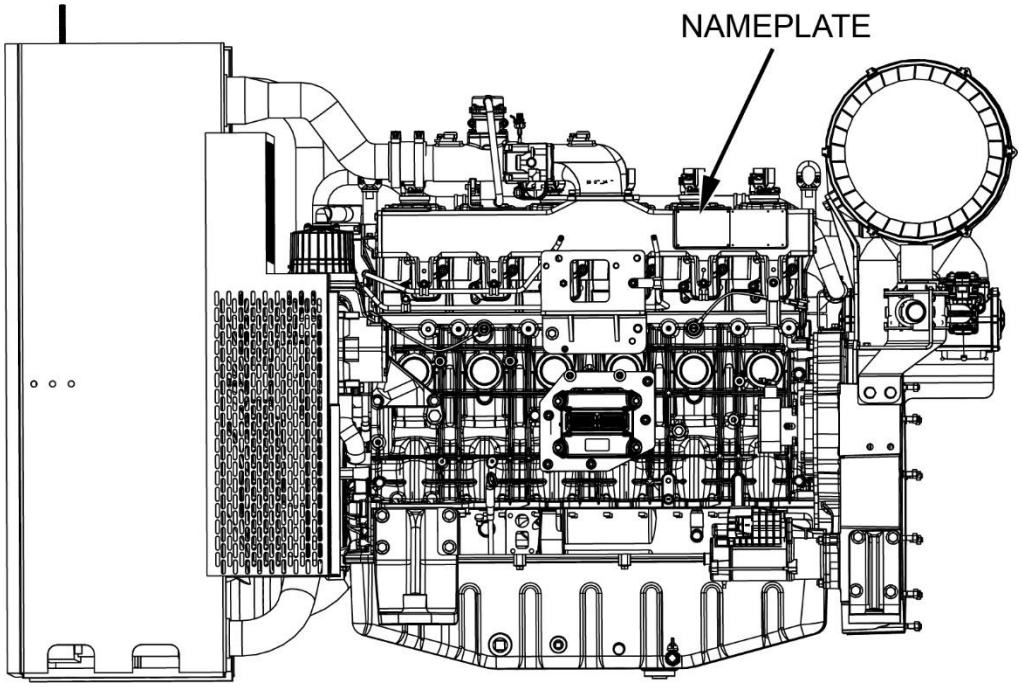


Illustration 4- Engine nameplate

See engine nameplate to find engine model, series number, rated power, rated speed, and weight.

More data as following table:

13LTHO Gas Engine Data

Item		Unit	Content
Engine type			13L Turbocharged
Number of cylinders			6
Displacement		L	12.54
Cylinder bore * stroke		mm	127 * 165
Compression ratio			10.5:1
Idle speed		rpm	1000
Fire order			1-5-3-6-2-4
Rotation			CCW viewed on flywheel
Oil pressure	Idle speed	KPa	400
	Rated speed	kPa	350~550
Oil temperature range (under rated condition)		℃	85~105
Oil capacity		L	26.5~30
Engine coolant capacity		L	22
Exhaust temperature		℃	700 post turbo
Intake valve lash (cold)		mm	0.5
Exhaust valve lash (cold)		mm	0.8
Spark plug gap		mm	0.45
Allow to tilt	Front / rear	°	5
	Air intake side / exhaust side	°	5
Dry Weight		kg	1050
Size (with radiator and air filter) (L*W*H)		mm	2264*1500*1781

Note: Oil Viscosity should be determined based on Ambient Temperature Operations.

U.S. EPA Legal Requirements

This engine has been certified by the U.S. Environmental Protection Agency (EPA) as a Non-road and stationary constant-speed engine. It is illegal to operate this engine in a variable-speed (foot pedal speed control) application.

A maintenance plan and log provided within this manual are for you to record your engine maintenance. Update the log each time you service your engine.

NOTE

The repair shop or person of the owner's choosing may maintain, replace, or repair emissions control devices and systems. The emissions warranty is not conditioned on the engine being serviced by a Weichai America/Power Solutions International, Inc. dealer or service establishment.

Emission Related Installation Instructions

WARNING

Failure to follow these instructions when installing a certified engine in a Non-Road equipment, violates Federal Law (40 CFR 1068.105(b)), subject to fines or other penalties as described in the Clean Air Act.

NOTE

To perform emission sampling, add a 20-centimeter extension to the exhaust pipe.

NOTE

If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a duplicate label on the equipment as described in 40 CFR 1068.105.

Personal Safety

WARNING

Improper operation of this machine could result in death or serious injury. Before operating any equipment, ensure every operator:

- Is instructed on safe operation and use of all equipment
- Fully understands all manuals and safety measures for all equipment before use
- Practices safety precautions for all equipment during operation
- Reads and fully understands all decals on equipment
- Clear the immediate area of all non-essential personnel before operating

WARNING

CALIFORNIA PROPOSITION 65

Engine exhaust from this production contains chemicals known to the State of California to cause cancer, birth defects and other reproductive harm.

CAUTION

Failure to follow these instructions could cause damage or decrease the life of equipment.

Weichai America Corp. and Power Solutions International, Inc. are continually striving to improve its products and therefore reserves the right to make improvements and changes when it becomes practical and/ or possible to do so, without incurring any obligation to make changes or additions to previously sold equipment.

NOTE

All data given in this manual is subject to production variations. Operating and service messages displayed on the electronic operating panel may vary from what is shown in the Operator's Manual. Please adhere to the instructions displayed on the Electronic Operation Panel.

Fuel Information

PSI Power Systems engines are designed and certified on commercially available pipeline quality natural gas. This standard is intended to further define pipeline quality gas.

		Natural Gas			Propane		
Fuel Constituent		**Low**	**High**	**Average**	**Low**	**High**	**Average**
Methane	CH_4	92	94.5	93.25	0	1.23	0.615
Ethane	C_2H_6	1	4.5	2.75	2.22	10.12	6.17
Propylene	C_3H_6			0			0
Propane	C_3H_8	0.09	0.44	0.265	87.68	96.7	92.19
i-Butane	C_4H_{10}	0	0.06	0.03	0.56	1.87	1.215
n-Butane	C_4H_{10}	0	0.12	0.06	0.04	1.28	0.66
i-Pentane	C_5H_{12}	0	0.02	0.01	0	0	0
n-Pentane	C_5H_{12}	0	0.01	0.005	0	0	0
Hexane+	C_6H_{14}	0	0.02	0.01	0	0	0
n-Heptane	C_7H_{16}						
n-Octane	C_8H_{18}						
n-Nonane	C_9H_{20}						
n-Decane	$C_{10}H_{22}$						
Hydrogen Sulfide	H_2S						
Carbon Dioxide	CO_2	0.05	0.25	0.15	0.11	0.01	0.06
Nitrogen	N_2	1.5	1.5	1.5	0.76	0.17	0.465
Oxygen	O_2						
Water (gas)	H_2O						
Specific Gravity ($S_g=M_{gas}/M_{air}$ where $M_{air}=28.964$g/mol)		0.537	0.600	0.568	1.379	1.649	1.514
Wobbe index (Iw=HHV/sqrt(Sg) where HHV =BTU/SCF)		**1295**	**1359**	**1328**	**1930**	**2125**	**2030**
Wobbe index (MJ/Sm3 1000Btu/scf=37.3MJ/Sm3)		**47.92**	**50.28**	**49.12**	**71.40**	**78.61**	**75.09**
LHV (Btu/cubic ft.)		857	952	904	2116	2563	2338
HHV (Btu/cubic ft.)		949	1053	1001	2266	2728	2497

If the gas is not commercially available pipeline quality gas that meets the above specification, it is the end user's responsibility to understand and comply with the certification regulations. Contact your PSI representative for more information on operating engines on non-standard fuels.

Oil and Coolant Information

Engine Oil

To achieve proper engine performance and durability, it is important that you use only engine lubricating oils of the correct quality in your engine, ensure. Proper quality oils also provide maximum efficiency for crankcase ventilation systems, which reduces pollution.

A multi-viscosity, low-ash gas engine oil should be used. Straight weight engine oils are not recommended. Do not use oils that are formulated only for use in diesel engines.

	SAE No.	Sulfated Ash Content byWeight	Engine Oil Capacity (min/max)	Recommended Oil
4.5L	15w-40	0.25 - 0.5% by wt. API CD/CF or higher	10 qts / 13 qts	Chevron HDAX 5200 LowAsh Gas Engine Oil
6.7L	15w-40	0.25 - 0.5% by wt. API CD/CF or higher	25 qts / 29 qts	Chevron HDAX 5200 LowAsh Gas Engine Oil
10L	15w-40	0.25 - 0.5% by wt. API CD/CF or higher	25 qts / 32 qts	Chevron HDAX 5200 LowAsh Gas Engine Oil
13L	15w-40	0.25 - 0.5% by wt. API CD/CF or higher	28 qts / 32 qts	Chevron HDAX 5200 LowAsh Gas Engine Oil

Engine Coolants

The cooling system must be filled with a 50/50 mix of coolant and distilled water. A NAPS-free coolant (free from nitrates, amines, phosphates, and silicates) should be used.

The coolant should be an organic acid technology (OAT) long-life variety, such as Chevron Delo XLC.

	Variety	Freezing/Boiling Point (°F)	Recommended Type	Engine Coolant Capacity (gal)
4.5L	OAT Long-Life EngineCoolant	-34 / 265	Chevron Delo XLC Antifreeze/ Coolant 50/50Mix	1.3 gal
6.7L	OAT Long- Life Engine Coolant	-34 / 265	Chevron Delo XLC Antifreeze/ Coolant 50/50Mix	2.1 gal
10L	OAT Long- Life Engine Coolant	-34 / 265	Chevron Delo XLC Antifreeze/ Coolant 50/50Mix	5.8 gal
13L	OAT Long- Life Engine Coolant	-34 / 265	Chevron Delo XLC Antifreeze/ Coolant 50/50Mix	7.1 gal

New Engine Break-in Procedures

The minimum requirements for engine start-up and break-in are listed below. These steps are necessary to ensure proper break-in of engine components and minimize premature engine wear.

Time	Time (Min)	Engine Speed (rpm)	Engine Load	Test Procedure
0-15min	15	1800	0%	**Start and run engine after filling radiator until thermostat opens. Continue to run for 5 min after thermostat has opened. Ensure that coolant level does not drop and temperature is stable. Shut engine down and check coolant and oil level.**
15-45min	30	1800	50%	**Break-in**
45-60min	15	1800	75%	**Break-in**
60-70min	10	1800	100%	**Load check**
??	??	1800	0-100%	**Optional customer requested performance testing**
End of Test	10	1800	0%	**Cool down**

Engine Loading

The gas engines are designed to operate continuously at industry accepted high ratings and to provide optimum service life. It is not recommended to operate a natural gas engine continuously at low load levels. A general rule used for most low emission natural gas engines is to operate at 60% load or above.

Rating Definition for Power Generation

All PSI Power Systems engines are sold with a designated rating of standby, limited time running power (LTP), or prime. These ratings are defined as follows:

Standby Power: Capable of supplying emergency power for the duration of a utility power outage. Typical emergency standby power is available for a maximum of 500 hours per year at a maximum average load factor of 70%. The load should be variable and there is no overload (operation above nameplate) available for a standby rated product.

Limited Time Running Power (LTP): Capable of supplying power to a load for a maximum of 500 hours per year. Typical operation is a varying load up to the full LTP nameplate rating of the engine. There is no overload capability available with an LTP rated engine. Operation allowance up to 1500 hours per year may be available. Please consult the factory for an application review.

Prime Rated Power: Capable of supplying power to a variable load for an unlimited number of hours per year. Typical operation is a varying load with an average maximum load factor of 70% of the prime power rating. A 10% overload rating is available for a maximum of one (1) hour in every twelve (12) hours and will not exceed 25 total hours per year.

All Power Solutions International ratings are in accordance with ISO 3046 and ISO 8528. Ratings are based on standard fuel as defined by PSI Power Systems Technical Standard 56100019 – PSI Power Systems Fuel Standard.

Engine Hoist

While lifting, the centerline of the crankshaft of the engine must be kept level; no tilt or single-point lifting. Lift and lower slowly (See Illustration 6)

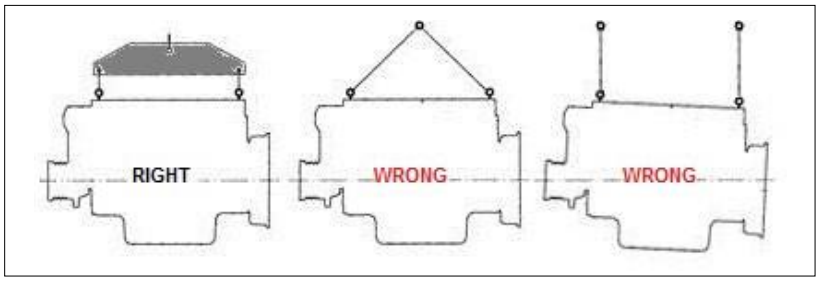


Illustration 5- Engine Installation Diagram

Extreme Operating Conditions

Engine Speed

This engine is designed to operate at constant speed (1000 to 2200 RPM) and should not exceed 2400 RPM for any length of time. If engine is operated at excessive RPM, fuel and ignition systems will shut down until engine RPM decreases to the recommended operating RPMs.

Over Temperature

CAUTION

To prevent engine damage, shut down engine immediately if the coolant reaches operating temperature above 230°F (110°C).

4.5L, 6.7L and 6.7LT have a top tank temperature of 101C, while the 10LNA, 10LT and 13LTHO have a top tank temperature of 110C.

WARNING

The use of starting fluids could create an extremely hazardous condition and is not authorized with this engine. The use of starting fluid could cause severe injury and/or damage to equipment.

Pre-Start Engine Check

- Verify engine oil level is correct
- Verify engine coolant level is correct
- Inspect engine for leaks or a frayed belt or any condition or appearance out of the ordinary
- Verify all belts and moving parts are clear of obstructions
- Verify the “Check Engine” light is on with the key in the “ON” position and the engine not running (if applicable)

Engine Operation

Engine Starting

With the controls in the idle position, start the engine. To prevent damage to the starter, do not engage the starter motor for more than fifteen (15) seconds. Wait two (2) minutes between each start attempt to allow the starter motor to cool.

If oil pressure reading does not indicate normal oil pressure(≥120kPa) within fifteen seconds of engine start, immediately shut down the engine to avoid damage to the engine. Service the engine prior to attempting to start engine again.

Performance

For monthly engine system check, idle the engine for at least one (1) minute before applying operating load. Verify the “Warning” light is not illuminated during engine operation. Inspect for fuel, coolant, and oil leaks with engine operating. If leaks are found, shut down the engine and repair leaks before operating engine.

Engine Shut-Down

If the engine has been running under load and reached operating temperature, run engine for five (5) minutes at idle without a load to allow engine to cool before engine shut down. The engine may run one to five seconds while the fuel is depleted from the engine’s fuel system.

Service Intervals

NOTE

Non-critical emission-related maintenance is not necessary to keep the emission-related warranty valid.

CAUTION

Failure to follow these scheduled maintenance intervals could cause engine damage or decreased engine life.

NOTE

Valve lash adjustments will be accomplished every 750 hours (1500, 2250, etc.) engine operating time on non-emergency. See Maintenance Tables.

NOTE

The oil change interval is based on “normal” operating conditions. Continuous operation during excessive hot or cold climate, constant operation with high loads, frequent starts and stops, poor quality lubricants and fuel contaminants would require more frequent oil change intervals to prevent shortening engine life.

NOTE

Always dispose of all chemicals and filters in accordance with Federal, State and Local laws and regulations.

WARNING

Before servicing engine, ensure the engine has stopped and all high voltage disconnect switches are in the open (disconnect position).

CAUTION

Failure to follow these procedures could cause engine damage or decreased engine life.

PSI POWER SYSTEMS ENGINE MAINTENANCE GUIDELINE – LIMITED TIME PRIME

Maintenance Table

PSI POWER SYSTEMS ENGINE MAINTENANCE GUIDELINES								
56100094 Revision: 2 2024-07-09	Service Intervals							
4.5L, 6.7LNA/T, 10LNA/T, 13LSO, 17L LTP	**Initial 50 Hour Service[1]**	**Daily**	**Every 250 hrs**	**Every 750 hrs**	**Every 1,500 hrs**	**Every 8,000 hrs**	**Every 16,000 hrs**	**Every 24,000 hrs (Overhaul)**
Check for fluid leaks	X	X						
Check engine oil level	X	X						
Check coolant level	X	X						
Inspect drive belts for tension, cracks, splits, or glazing	X		X					
Inspect air cleaner filter element, replace as needed	X		X					
Sample engine oil as needed[2]	x2		x2					
Change engine oil and filter[2]	x2			x2				
Grease signal generator (NLGI Gr.2)	X			X				
Inspect electrical system and harnesses for cuts, abrasions or wear	X			X				
Inspect all vacuum lines and fittings for cracks, breaks or hardening	X			X				
Inspect automatic belt tensioners, replace if necessary	X			X				
Inspect coolant hoses for cracks, swelling or deterioration	X			X				
Inspect Fuel Shut-off Valves for leaks and proper operation	X			X				
Inspect gas piping and hoses for leaks or damage	X			X				
Inspect air induction piping for leaks	X			X				
Inspect intake manifold for vacuum leaks	X			X				
Inspect exhaust manifold for leaks	X			X				
Inspect exhaust piping for leaks	X			X				
Inspect O_2 sensors and harness for damage/performance	X			X				
Inspect catalyst for mechanical damage and performance	X			X				
Clean debris from radiator core	X			X				
Measure intake and exhaust valve clearance, reset as necessary	X			X				
Tighten all hose clamps on CAC piping boots	X			X				
Drain LPL vaporizer oil build up (if LP fuel system is installed)	X			X				
Inspect ignition coils, coil boots, and harness				X				
Inspect crankcase ventilation filter, replace if required				X				
Replace spark plugs				X				
Replace fan belt and water pump belt					X			
Drain, flush, and replace engine coolant[2]						x2		
Inspect O_2 sensor performance, replace if necessary[3]						x3		
Inspect catalyst performance, replace if necessary[3]						x3		
Replace ignition coils and boots						X		
Replace throttle bodies						X		
Replace coolant pumps						X		
Replace engine alternator						X		
Replace thermostats, gaskets and O-rings						X		
Replace cylinder heads[4]						x4		
Replace rocker arm assemblies						X		
Replace turbocharger assembly (if equipped)						X		
Replace cooling fan hub							X	
Replace unfiltered crankcase ventilation system, if applicable							X	
Replace oil coolers[4]							x4	
Replace camshaft, bearings, seals, lifters, pushrods, and timing gears							X	
Replace exhaust manifold assembly and gaskets[4]							x4	
Replace piston and connecting rod assemblies and cylinder liners[4]							x4	
Replace fuel mixers							X	

Replace EPRs							X	
Replace fuel lock-off valves							X	
Replace crankshaft assembly, bearings and seals								X
Replace oil pump								X
Replace front accessory drive pulleys, idlers and seals								X

PSI POWER SYSTEMS ENGINE MAINTENANCE GUIDELINES - Continued								
56100094 Revision: 2 2024-07-09	**Service Intervals - LTP**							
4.5L, 6.7LNA/T, 10LNA/T & 13LTHO	**Initial 50 Hour Service 1**	**Daily**	**Every 250 hrs**	**Every 750 hrs**	**Every 1,500 hrs**	**Every 8,000 hrs**	**Every 16,000 hrs**	**Every 24,000 hrs (Overhaul)**
Replace spark plugs				X				
Replace fan belt and water pump belt					X			
Drain, flush, and replace engine coolant[2]						x2		
Inspect O_2 sensor performance, replace if necessary[3]						x3		
Inspect catalyst performance, replace if necessary[3]						x3		
Replace ignition coils and boots						X		
Replace throttle bodies						X		
Replace coolant pumps						X		
Replace engine alternator						X		
Replace thermostats, gaskets and O-rings						X		
Replace cylinder heads[4]						x4		
Replace rocker arm assemblies						X		
Replace turbocharger assembly (if equipped)						X		
Replace cooling fan hub							X	
Replace unfiltered crankcase ventilation system, if applicable							X	
Replace oil coolers[4]							x4	
Replace camshaft, bearings, seals, lifters, pushrods, and timing gears							X	
Replace exhaust manifold assembly and gaskets[4]							x4	
Replace piston and connecting rod assemblies and cylinder liners[4]							x4	
Replace fuel mixers							X	
Replace EPRs							X	
Replace fuel lock-off valves							X	
Replace crankshaft assembly, bearings and seals								X
Replace oil pump								X
Replace front accessory drive pulleys, idlers and seals								X

1: Perform after initial 50 hours of engine operation, and 50 hours after top end or overhaul service

2: Oil and filter change should be performed annually or every 750 hours of engine operation, whichever comes first. Oil and coolant change intervals can be extended only with a regularly scheduled sampling and lab analysis program

3: Expected life of catalysts and O2 sensors is 8760 hours. Actual life may vary based on application.

4: Based on 0.11 starts per hour or 1 start/10 hours. If application exceeds this contact PSI engineering

The service life of an engine is influenced by several factors including correct installation, operating at proper rated load, proper service and inspection by trained technicians, and the use of approved engine oil, filters, and coolant.

PSI POWER SYSTEMS ENGINE MAINTENANCE GUIDELINE – PRIME

PSI POWER SYSTEMS ENGINE MAINTENANCE GUIDELINES								
56100094 Revision: 2 2024-07-08	**Service Intervals - PRIME**							
4.5L, 6.7LNA/T, 10LNA/T & 13LTHO Prime	**Initial 50 Hour Service 1**	**Daily**	**Every 250 hrs**	**Every 750 hrs**	**Every 1,500 hrs**	**Every 8,000 hrs**	**Every 16,000 hrs**	**Every 24,000 hrs (Overhaul)**
Check for fluid leaks	X	X						
Check engine oil level	X	X						
Check coolant level	X	X						
Inspect drive belts for tension, cracks, splits, or glazing	X		X					
Inspect air cleaner filter element, replace as needed	X		X					
Sample engine oil as needed[2]	X2		X2					
Change engine oil and filter[2]	X2			X2				
Grease signal generator (NLGI Gr.2)	X			X				
Inspect all vacuum lines and fittings for cracks, breaks or hardening	X			X				
Inspect automatic belt tensioners, replace if necessary	X			X				
Inspect coolant hoses for cracks, swelling or deterioration	X			X				
Inspect Fuel Shut-off Valves for leaks and proper operation	X			X				
Inspect gas piping and hoses for leaks or damage	X			X				
Inspect air induction piping for leaks	X			X				
Inspect intake manifold for vacuum leaks	X			X				
Inspect exhaust manifold for leaks	X			X				
Inspect exhaust piping for leaks	X			X				
Inspect O_2 sensors and harness for damage/performance	X			X				
Inspect catalyst for mechanical damage and performance	X			X				
Clean debris from radiator core	X			X				
Measure intake and exhaust valve clearance, reset as necessary	X			X				
Tighten all hose clamps on CAC piping boots	X			X				
Drain LPL vaporizer oil build up (if LP fuel system is installed)	X			X				
Inspect ignition coils, coil boots, and harness				X				
Inspect crankcase ventilation filter, replace if required				X				
Replace spark plugs				X				
Replace fan belt and water pump belt					X			
Drain, flush, and replace engine coolant[2]						X2		
Inspect O_2 sensor performance, replace if necessary[3]						X3		

PSI POWER SYSTEMS ENGINE MAINTENANCE GUIDELINES - Continued								
56100094 Revision: 2 2024-07-08	**Service Intervals - PRIME**							
4.5L, 6.7LNA/T, 10LNA/T & 13LTHO Prime	**Initial 50 Hour Service 1**	**Daily**	**Every 250 hrs**	**Every 750 hrs**	**Every 1,500 hrs**	**Every 8,000 hrs**	**Every 16,000 hrs**	**Every 24,000 hrs (Overhaul)**
Inspect catalyst performance, replace if necessary[3]						x3		
Replace ignition coils and boots						X		
Replace throttle bodies						X		
Replace coolant pumps						X		
Replace engine alternator						X		
Replace thermostats, gaskets and O-rings						X		
Replace cylinder heads						X		
Replace rocker arm assemblies						X		
Replace turbocharger assembly (if equipped)						X		
Replace cooling fan hub							X	
Replace unfiltered crankcase ventilation system, if applicable							X	
Replace oil coolers							X	
Replace camshaft, bearings, seals, lifters, pushrods, and timing gears							X	
Replace exhaust manifold assembly and gaskets							X	
Replace piston and connecting rod assemblies and cylinder liners							X	
Replace fuel mixers							X	
Replace EPRs							X	
Replace fuel lock-off valves							X	
Replace crankshaft assembly, bearings and seals								X
Replace oil pump								X
Replace front accessory drive pulleys, idlers and seals								X

1: Perform after initial 50 hours of engine operation, and 50 hours after top end or overhaul service

2: Oil and filter change should be performed annually or every 750 hours of engine operation, whichever comes first. Oil and coolant change intervals can be extended only with a regularly scheduled sampling and lab analysis program.

3: Expected life of catalysts and O2 sensors is 8760 hours. Actual life may vary based on application.

The service life of an engine is influenced by several factors including correct installation, operating at proper rated load, proper service and inspection by trained technicians, and the use of approved engine oil, filters, and coolant.

PSI POWER SYSTEMS ENGINE MAINTENANCE GUIDELINE – STANDBY

PSI POWER SYSTEMS ENGINE MAINTENANCE GUIDELINES - Continued			
56100094 Revision: 2 2024-07-09	**Service Intervals - STANDBY**		
4.5L, 6.7LNA/T, 10LNA/T & 13LTHO Standby	**Initial 50 Hour Service 1**	**Every 500hrs/Annual Service**	**Every 1,000hrs/Every Two Years**
Check for fluid leaks	X	X	
Check engine oil level	X	X	
Check coolant level	X	X	
Inspect drive belts for tension, cracks, splits, or glazing	X	X	
Inspect air cleaner filter element, replace as needed	X	X	
Inspect CCV filter element, replace as needed	X	X	
Inspect electrical system and harnesses for cuts, abrasions or wear	X	X	
Inspect all vacuum lines and fittings for cracks, breaks or hardening	X	X	
Inspect coolant hoses for cracks, swelling or deterioration	X	X	
Inspect Fuel Shut-off Valves for leaks and proper operation	X	X	
Inspect gas piping and hoses for leaks or damage	X	X	
Check air induction piping for leaks	X	X	
Inspect automatic belt tensioners, replace if necessary	X	X	
Check intake manifold for vacuum leaks	X	X	
Inspect exhaust manifold for leaks	X	X	
Inspect exhaust piping for leaks	X	X	
Inspect O_2 sensors and harness for damage/performance[3]	X[3]	X[3]	
Inspect catalyst for mechanical damage and performance[3]	X[3]	X[3]	
Sample engine oil as needed[2]	X[2]	X[2]	
Grease signal generator (NLGI Gr.2)	X	X	
Change engine oil and filter[2]	X[2]	X[2]	
Adjust intake and exhaust valve clearance	X	X	
Clean debris from radiator core	X	X	
Tighten all hose clamps on CAC piping boots	X	X	
Drain LPL vaporizer oil build up (if LP fuel system is installed)	X	X	
Inspect ignition coils and harness		X	
Replace throttle bodies		X	
Replace spark plugs			X
Drain, flush, and replace engine coolant[2]			X[2]
Replace fan belt and water pump belt			X
Replace ignition coils			X

1: Perform after initial 50 hours of engine operation, and 50 hours after top end or overhaul service.

2: Oil and filter change should be performed annually or every 750 hours of engine operation, whichever comes first. Oil and coolant change intervals can be extended only with a regularly scheduled sampling and lab analysis program.

3: Expected life of catalysts and O2 sensors is 8760 hours. Actual life may vary based on application.

The service life of an engine is influenced by several factors including correct installation, operating at proper rated load, proper service and inspection by trained technicians, and the use of approved engine oil, filters, and coolant.

Gas Engine Maintenance Procedures

Check Engine Oil

A. Ensure engine is level.
B. Pull dipstick after the engine stop running at least 5 minutes.
C. Ensure oil level is between high and low marks.

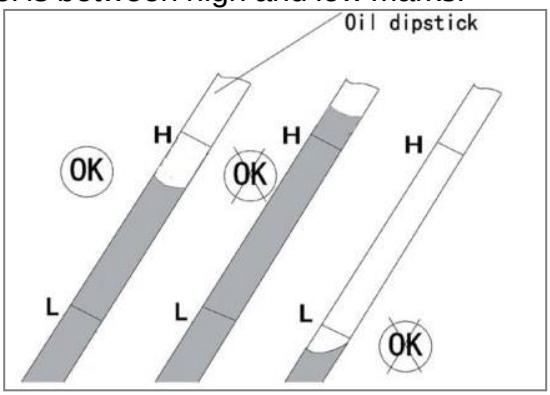


Illustration 6

D. If the oil level is below the low mark, add additional oil as necessary.
E. Install dipstick.

Check Coolant Level

Caution: Never remove radiator or top tank cap when coolant is hot! Burns and physical harm may occur.

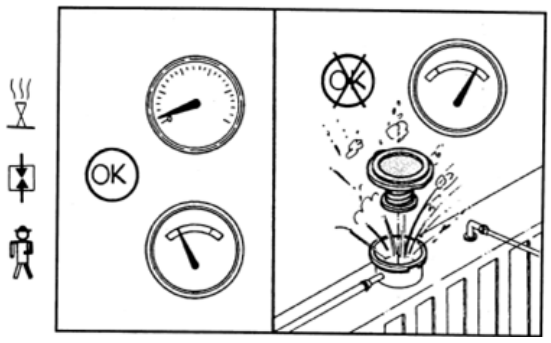


Illustration 7

A. When coolant is room temperature or below, remove pressurized cap and inspect top tank or radiator for fluid level.
B. If the engine has a sight gauge or plastic top tank, a visual level check is adequate.
C. If coolant level is low, determine reason for low fluid and top off with specified coolant.
D. Test pressurized cap (replace if necessary or reinstall).

Check Oil Pressure

A. When engine is running and at normal operating temperature, check oil pressure gauge.
    i. Some engines will have an analog gauge and others will have an electronic gauge from the ECU.

B. Ensure oil pressure is in the range of the table below both at idle and rated speed and operating temperature.

		Idle	Min	Rated Speed	Min	Max
Oil Pressure	**4.5L**	**PSI**	17		43	80
		KPa	120		300	550
	6.7L	**PSI**	17		43	87
		KPa	120		300	600
	10L	**PSI**	19		50	84
		KPa	>130		350	580
	13L	**PSI**	19		50	84
		KPa	>130		350	550

Table 15

Check Overall Operating Condition

A. Inspect hoses, pipes and clamps for loose connections or leaks.

B. Check the belt for fraying or damage.

C. Look for fluid leaks under and around the engine.

D. Inspect ignition wires and system for routing and connections.

E. Inspect the engine harness for corrosion, abrasions, cuts or shorts.

F. Look around the engine for any debris or loose materials that might become a hazard.

G. Assure battery voltage is ≥12v each and terminal connections are clean and tight.

Change Oil and Oil Filter Materials:

NOTE: Recommended oil is: Chevron HDAX 5200 Low Ash Gas Engine Oil.

NOTE: For continuous operation in extreme temperatures or in excessively dusty, dirty environments, rely on oil analysis to determine maintenance intervals.

NOTE: For best results, change engine oil while engine is still warm from operation.

A. Remove the oil pan drain plug and drain oil completely.

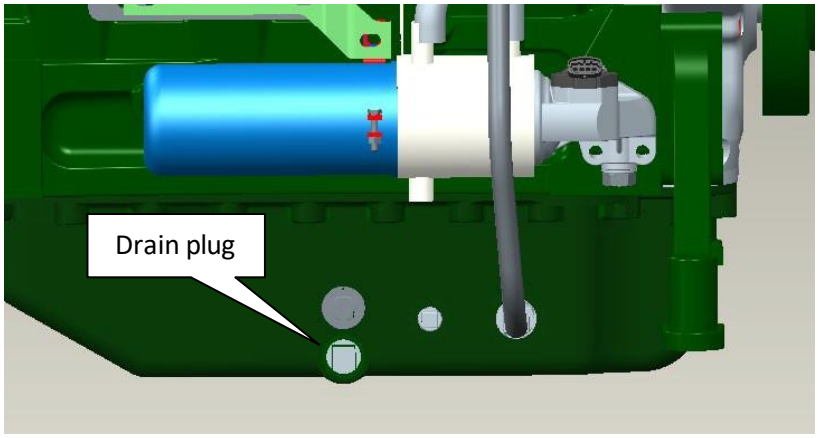


Illustration 8 – 4.5L

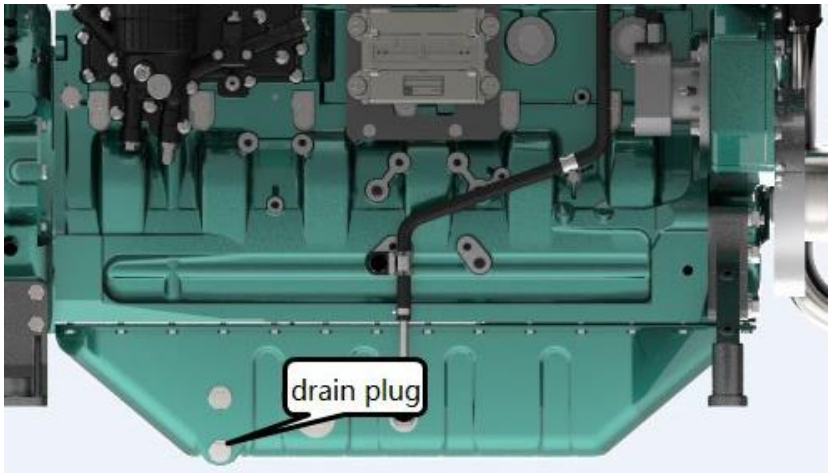


Illustration 9 – 6.7L

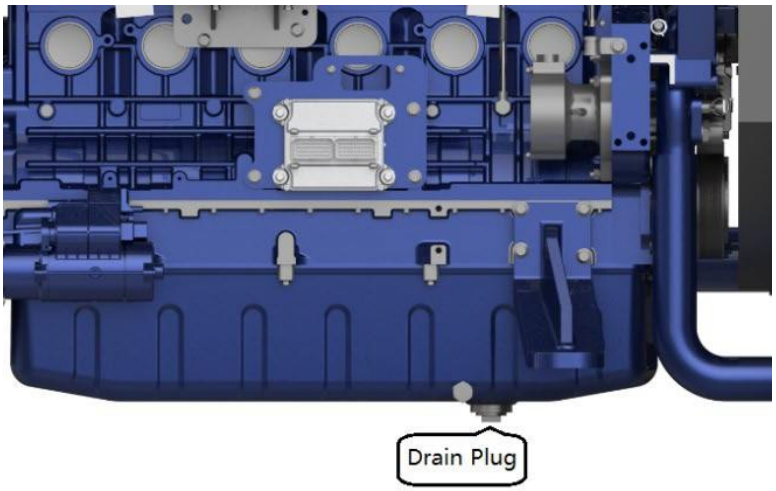


Illustration 10 – 10L

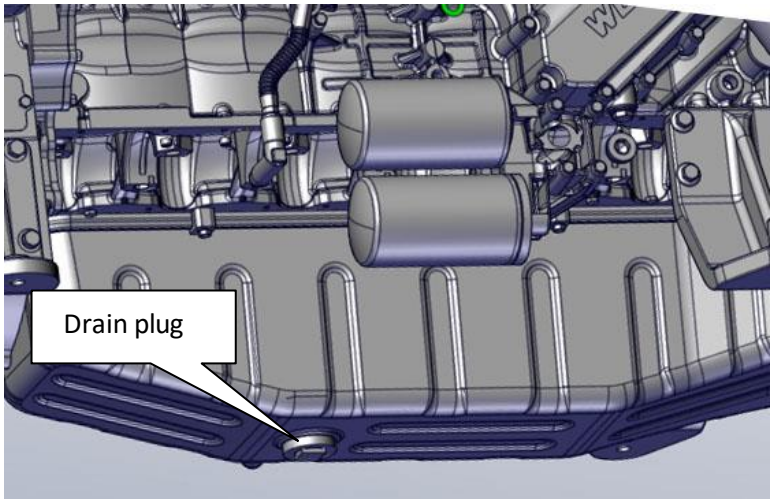


Illustration 11 – 13L

B. Inspect drain plug washer (replace if necessary) and clean plug seating surface.

C. Inspect magnetic plug for iron and ferrous material. If this exists, consider an oil analysis to determine source of debris.

D. Reinstall drain plug and tighten securely.

E. Remove the old filters (if equipped) by the filter wrench. Wipe filter base clean. Then apply a thin coat of motor oil to O-ring on new oil filter(s).

F. Install oil filter. Tighten filter until the rubber gasket contacts base. Tighten an additional 3/4 to 1 turn to seal.

G. Using the recommended grade of oil, fill crankcase with specified quantity.

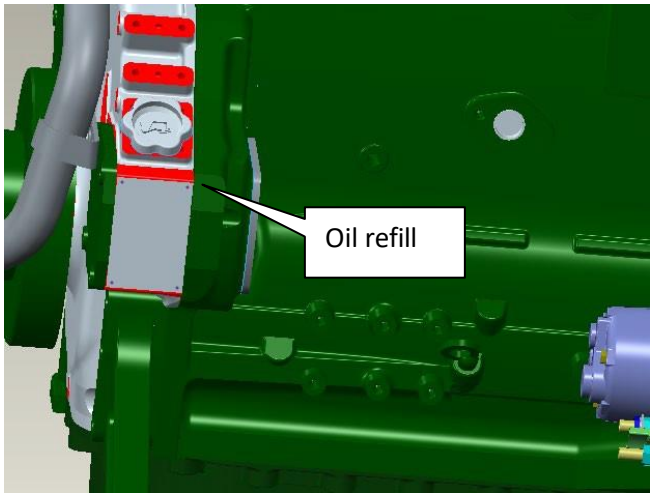


Illustration 12 – 4.5L

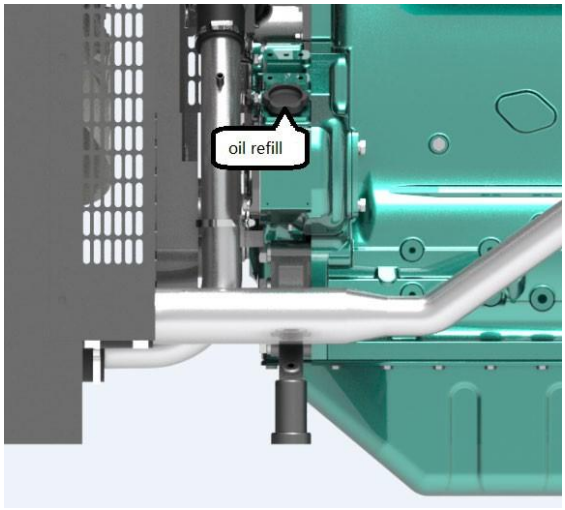


Illustration 13 – 6.7L

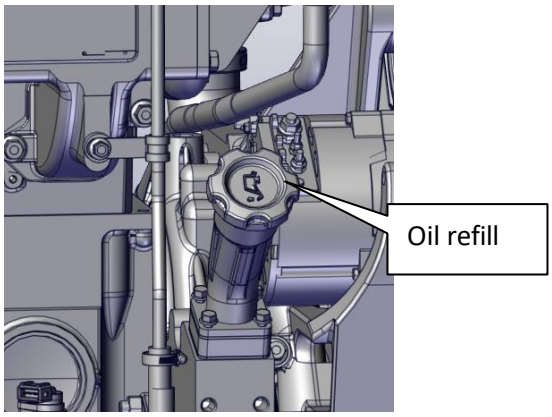


Illustration 14 – 10L

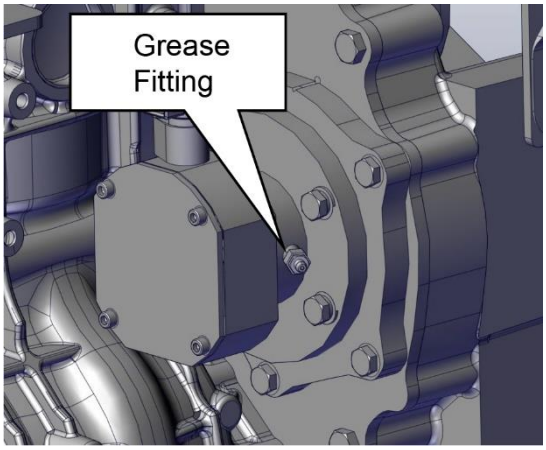


Illustration 15 – 13L

Fill the grease cup of the signal generator with lithium grease (NLGI Gr. 2) with the grease fitting.

H. Operate engine for five (5) minutes. Check for leaks at filter base and oil pan drain plug during operation.

I. Shut down engine and wait five (5) minutes. Check engine oil level and adjust to proper level if necessary.

Engine Valve Lash Inspection/Adjustment – 4.5L

NOTE:

- **Required every 750 hours (1500, 2250, etc.) on non-emergency.**
- **Measure and adjust while engine is cold.**

NOTE

Confirm that #1 piston is on the compression stroke by turning both pushrods by hand to verify that both valves are closed. The valves are closed when the push rods are loose and can be turned easily.

Engine can be barred over by installing 8mm-1.25 bolts in the six empty holes around the crankshaft pulley and using a pry bar to turn the crankshaft.

A. Remove all valve covers.

B. Rotate the crankshaft until the number 1 piston is on the compression stroke and the timing pointer on the front cover is in-line with the “TDC” mark on the crankshaft damper. Some engines may have a permanent groove mark on the flywheel for “TDC”.

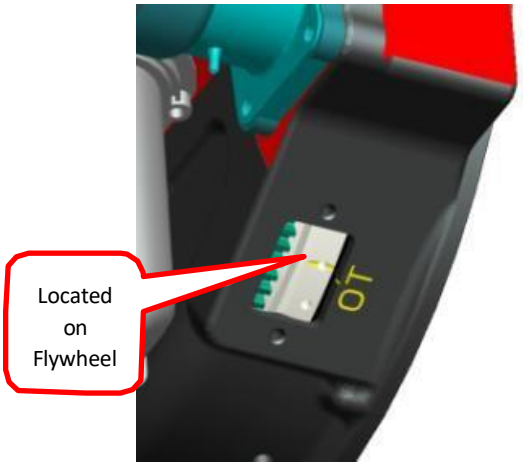


Illustration 16

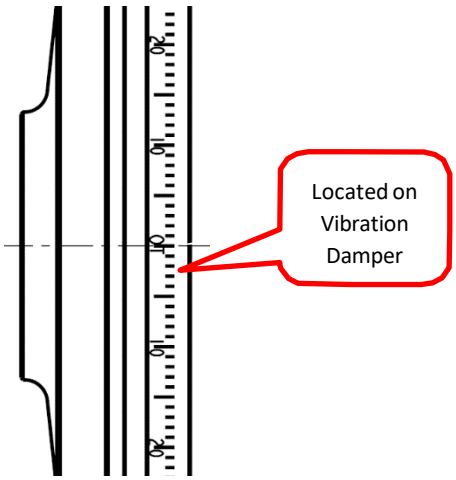


Illustration 17

C. Using Illustration 21, adjust the four (4) valves corresponding with cylinder 1 “TDC”. Insert the correct feeler gauge between the rocker arm and valve stem tip. Loosen the locknut and turn the valve adjustment screw until the rocker arm and valve stem tip contact the feeler gauge.

D. Tighten the locknut once the valve is adjusted properly. Remove the feeler gauge. A very slight resistance should be felt when removing the feeler gauge.

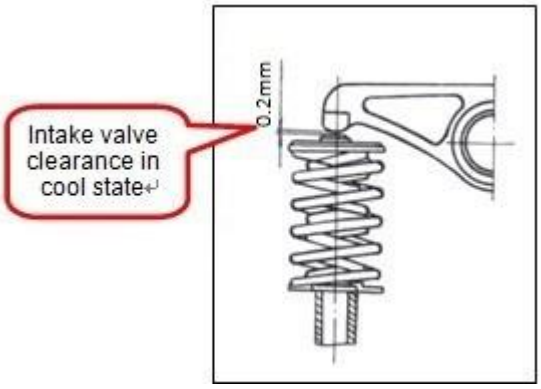


Illustration 18

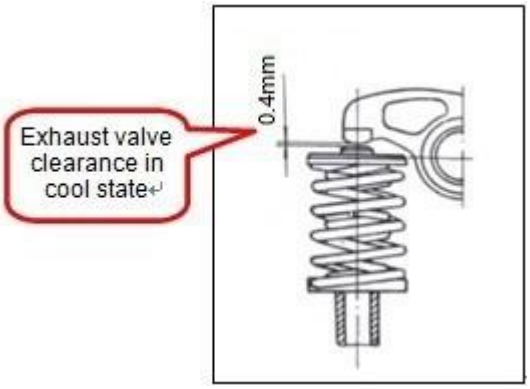


Illustration 19

E. Rotate the crankshaft (360°) until the number 4 piston is on the compression stroke and the timing pointer on the front cover is in line with the “TDC” mark on the vibration dampener.

F. Using Illustration 22, adjust the four (4) valves corresponding with the cylinder 4 “TDC”. Insert the correct feeler gauge between the rocker arm and valve stem tip. Loosen the locknut and turn the valve adjustment screw until the rocker are and valve stem tip contact the feeler gauge.

G. Tighten the locknut once the valve is adjusted properly. Remove the feeler gauge. A very slight resistance should be felt when removing the feeler gauge.

NOTE

Ensure valve cover is completely seated and not resting on bolts or washers adjacent to the valve cover.

H. Install gasket onto the valve cover and align the cover and gasket onto the cylinder head. Tighten the valve cover mounting bolts to 36 in/lbs. Ensure valve cover gasket is aligned before tightening.

With #1 piston at “TDC”, adjust these valves to: 4.5L Exhaust 0.4mm/0.016” / Intake 0.2mm/0.008”;

	INT	EXH	INT	EXT
#1@TDC	1	1	2	3

Illustration 20

With #4 piston at “TDC” adjust these valves to: 4.5L Exhaust 0.4mm/0.016” / Intake 0.2mm/0.008”.

	EXH	INT	EXH	INT
#4@TDC	2	3	4	4

Illustration 21

Engine Valve Lash Inspection/Adjustment – 6.7L

NOTE:

- **Required every 750 hours (1500, 2250, etc.) on non-emergency.**
- **Measure and adjust while engine is cold.**

NOTE

Confirm that #1 piston is on the compression stroke by turning both pushrods by hand to verify that both valves are closed. The valves are closed when the push rods are loose and can be turned easily.

Engine can be barred over by installing 8mm-1.25 bolts in the six empty holes around the crankshaft pulley and using a pry bar to turn the crankshaft.

A. Remove all valve covers.

B. Rotate the crankshaft until the number 1 piston is on the compression stroke and the timing pointer on the front cover is in-line with the “TDC” mark on the crankshaft damper. Some engines may have a permanent groove mark on the flywheel for “TDC”.

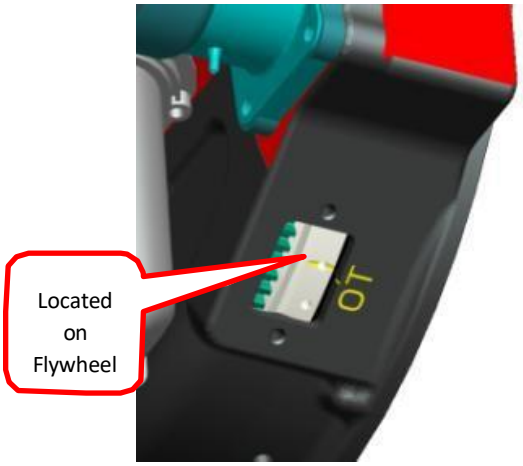


Illustration 22

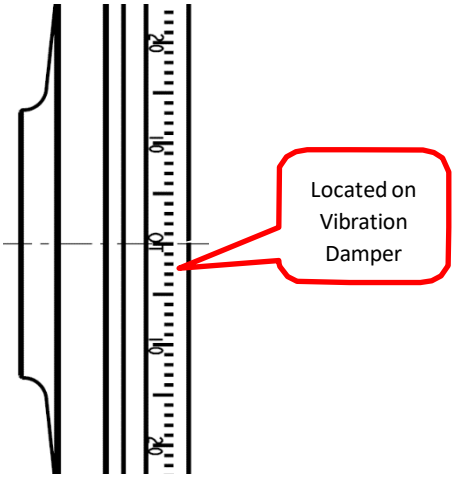


Illustration 23

C. Using Illustration 24, adjust the four (4) valves corresponding with cylinder 1 “TDC”. Insert the correct feeler gauge between the rocker arm and valve stem tip. Loosen the locknut and turn the valve adjustment screw until the rocker arm and valve stem tip contact the feeler gauge.

D. Tighten the locknut once the valve is adjusted properly. Remove the feeler gauge. A very slight resistance should be felt when removing the feeler gauge.

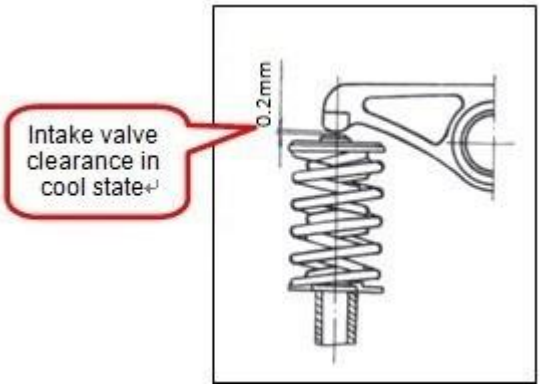


Illustration 24

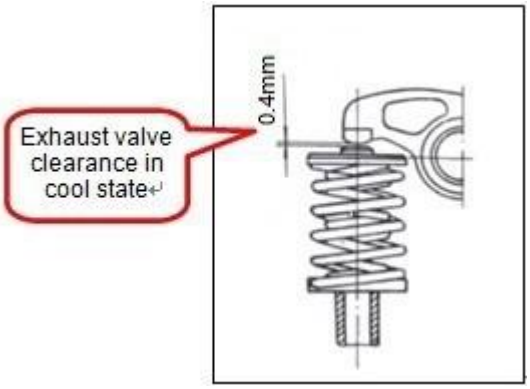


Illustration 25

E. Rotate the crankshaft (360°) until the number 4 piston is on the compression stroke and the timing pointer on the front cover is in line with the “TDC” mark on the vibration dampener.

F. Using Illustration 25, adjust the four (4) valves corresponding with the cylinder 4 “TDC”. Insert the correct feeler gauge between the rocker arm and valve stem tip. Loosen the locknut and turn the valve adjustment screw until the rocker are and valve stem tip contact the feeler gauge.

G. Tighten the locknut once the valve is adjusted properly. Remove the feeler gauge. A very slight resistance should be felt when removing the feeler gauge.

NOTE

Ensure valve cover is completely seated and not resting on bolts or washers adjacent to the valve cover.

H. Install gasket onto the valve cover and align the cover and gasket onto the cylinder head. Tighten the valve cover mounting bolts to 36 in/lbs. Ensure valve cover gasket is aligned before tightening.

With #1 piston at “TDC”, adjust these valves to: 6.7 & 6.7L Turbo Exhaust 0.4mm/0.016” / Intake 0.2mm/0.008”

	INT	EXH	INT	EXT	INT	EXH
#1@TDC	1	1	2	3	4	5

Illustration 26

With #4 piston at “TDC” adjust these valves to: 6.7L & 6.7L Turbo Exhaust 0.4mm/0.016” / Intake 0.2mm/0.008”.

	EXH	INT	EXH	INT	EXH	INT
#6@TDC	2	3	4	5	6	6

Illustration 27

Engine Valve Lash Adjustment – 10L

NOTE:

- **Required every 750 hours (1500, 2250, etc.) on non-emergency.**
- **Measure and adjust while engine is cold.**

NOTE

Confirm that #1 piston is on the compression stroke by turning both pushrods by hand to verify that both valves are closed. The valves are closed when the push rods are loose and can be turned easily.

Engine can be barred over by installing 8mm-1.25 bolts in the six empty holes around the crankshaft pulley and using a pry bar to turn the crankshaft.

A. Remove all valve covers.
B. Rotate the crankshaft until the number 1 piston is on the compression stroke and the timing pointer on the front cover is in-line with the “TDC” mark on the crankshaft damper. Some engines may have a permanent groove mark on the flywheel for “TDC”.

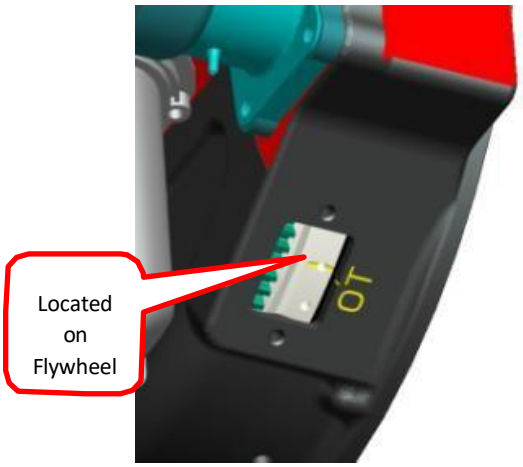


Illustration 28

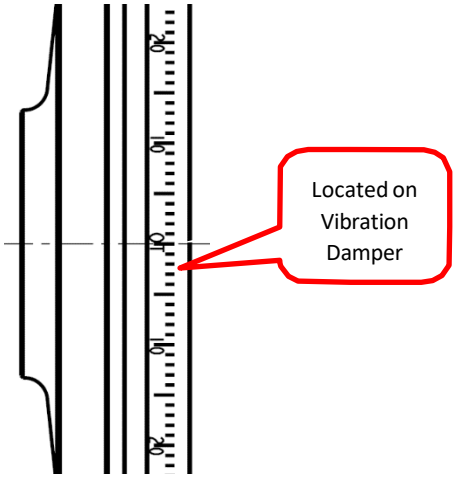


Illustration 29

C. Using Illustration 30, adjust the six (6) valves corresponding with cylinder 1 “TDC”. Insert the correct feeler gauge between the rocker arm and valve bridge. Loosen the locknut and turn the valve adjustment screw until the rocker arm and valve bridge contact the feeler gauge.
D. Tighten the locknut once the valve is adjusted properly. Remove the feeler gauge. A very slight resistance should be felt when removing the feeler gauge.

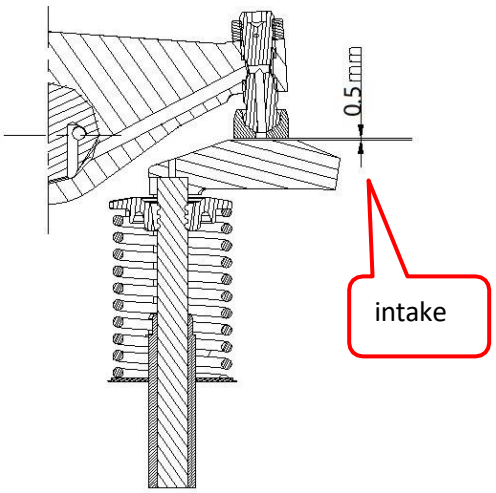


Illustration 30

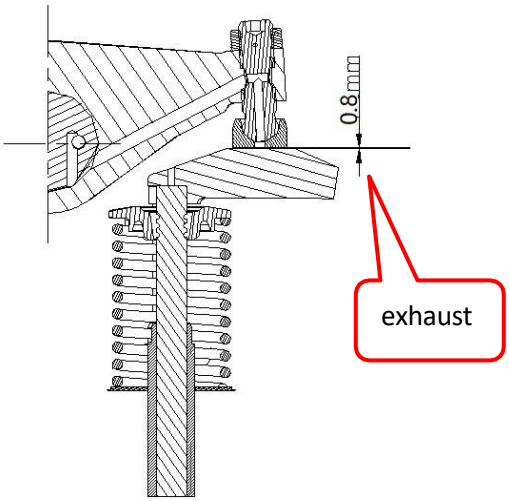


Illustration 31

E. Rotate the crankshaft (360°) until the number 6 piston is on the compression stroke and the timing pointer on the front cover is in line with the “TDC” mark on the vibration dampener.
F. Using Illustration 31, adjust the six (6) valves corresponding with the cylinder 6 “TDC”. Insert the correct feeler gauge between the rocker arm and valve bridge. Loosen the

locknut and turn the valve adjustment screw until the rocker are and valve bridge contact the feeler gauge.

G. Tighten the locknut once the valve is adjusted properly. Remove the feeler gauge. A very slight resistance should be felt when removing the feeler gauge.

NOTE

Ensure valve cover is completely seated and not resting on bolts or washers adjacent to the valve cover.

H. Install gasket onto the valve cover and align the cover and gasket onto the cylinder head. Tighten the valve cover mounting bolts. Ensure valve cover gasket is aligned before tightening.

With #1 piston at “TDC”, adjust these valves to: Exhaust 0.8mm/0.031” / Intake 0.5mm/0.02”

	INT	EXH	INT	EXT	INT	EXH
#1@TDC	1	1	2	3	4	5

Illustration 32

With #6 piston at “TDC” adjust these valves to Exhaust 0.8mm/0.031” / Intake 0.5mm/0.02”.

	EXH	INT	EXH	INT	EXH	INT
#6@TDC	2	3	4	5	6	6

Illustration 33

Engine Valve Lash Adjustment – 13L

NOTE:

- **Required every 750 hours (1500, 2250, etc.) on non-emergency.**
- **Measure and adjust while engine is cold.**

NOTE
Confirm that #1 piston is on the compression stroke by turning both pushrods by hand to verifythat both valves are closed. The valves are closed when the push rods are loose and can be turned easily.

Engine can be barred over by installing bolts in the empty holes around the crankshaft pulley and using a pry bar to turn the crankshaft.

A. Remove all valve covers.

B. Rotate the crankshaft until the number 1 piston is on the compression stroke and the timing pointer on the front cover is in-line with the “TDC” mark on the crankshaft damper. Some engines may have a permanent groove mark on the flywheel for “TDC”.

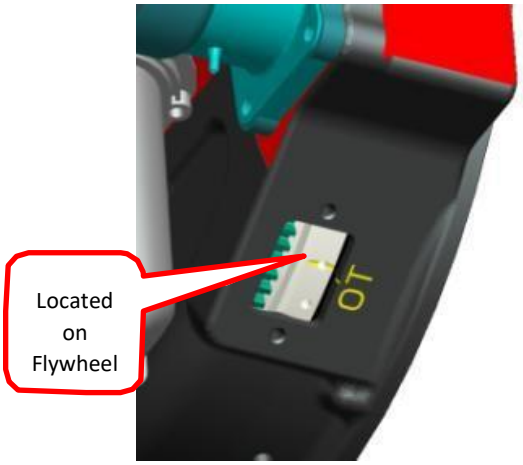


Illustration 34

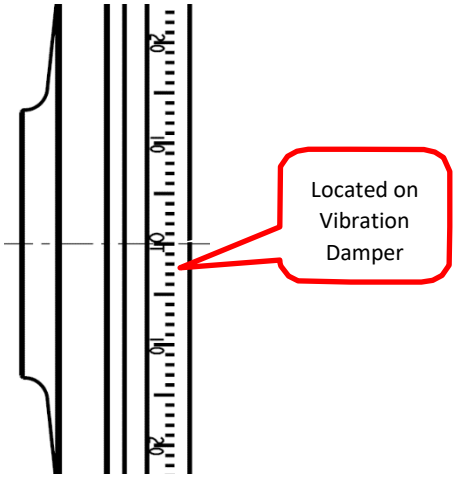


Illustration 35

C. Using Illustration 36, adjust the six (6) valves corresponding with cylinder 1 “TDC”. Insert the correct feeler gauge between the rocker arm and valve stem tip. Loosen the locknut and turn the valve adjustment screw until the rocker arm and valve stem tip contact the feeler gauge.

D. Tighten the locknut once the valve is adjusted properly. Remove the feeler gauge. A very slight resistance should be felt when removing the feeler gauge.

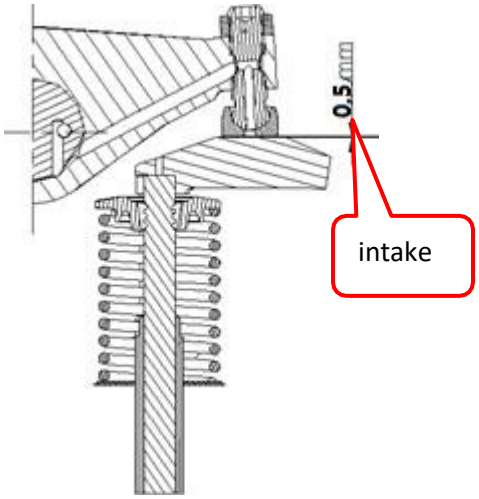


Illustration 36

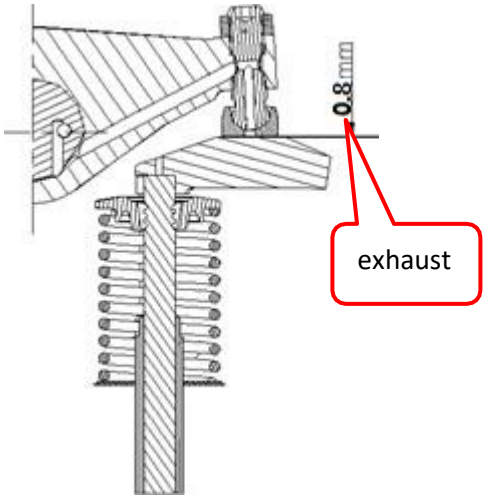


Illustration 37

E. Rotate the crankshaft (360°) until the number 6 piston is on the compression stroke and the timing pointer on the front cover is in line with the “TDC” mark on the vibration dampener.

F. Using Illustration 37, adjust the six (6) valves corresponding with the cylinder 6 “TDC”. Insert the correct feeler gauge between the rocker arm and valve stem tip. Loosen the locknut and turn the valve adjustment screw until the rocker are and valve stem tip contact the feeler gauge.

G. Tighten the locknut once the valve is adjusted properly. Remove the feeler gauge. A very slight resistance should be felt when removing the feeler gauge.

NOTE

Ensure valve cover is completely seated and not resting on bolts or washersadjacent to the valve cover.

H. Install gasket onto the valve cover and align the cover and gasket onto the cylinder head. Tighten the valve cover mounting bolts. Ensure valve cover gasket is aligned before tightening.

With #1 piston at “TDC”, adjust these valves to: Exhaust 0.8mm/0.031” / Intake 0.5mm/0.02”

	INT	EXH	INT	EXT	INT	EXH
#1@TDC	1	1	2	3	4	5

Illustration 38

With #6 piston at “TDC” adjust these valves to Exhaust 0.8mm/0.031” / Intake 0.5mm/0.02”.

	EXH	INT	EXH	INT	EXH	INT
#6@TDC	2	3	4	5	6	6

Illustration 39

Inspect Spark Plugs

A. Inspect high tension leads from coils for shorts, cracking and damage. (if used)

B. Remove/blow out any debris from the cylinder head spark plug hole before removing the spark plug to prevent any debris falling into the combustion chamber.

C. Remove wires or coil on plug (COP) from spark plugs.

D. Remove the spark plug and inspect the electrode and threads for wear or debris.

E. If the plugs do not show wear or debris or damage, re-gap and reinstall.

- (4.5L: 0.014”/0.35mm gap).
- (6.7L: 0.014”/0.35mm gap)
- (10L: 0.02”/0.045mm gap)
- (13L: 0.02”/0.045mm gap)

F. If the plugs have debris or wear or damage, replace them with new plugs.

CAUTION

Before installing spark plug, ensure plug and cylinder threads are clean and undamaged.
Torque spark plugs to specifications. Over-tightened can cause damage and removal of spark plug difficult. Under-tightened could cause the spark plug to overheat, resulting in pre-ignition and possible engine damage.

G. Install new spark plug. Torque to 18 – 20 ft. lbs. (25 – 28N·m)

H. Apply spark plug boot dielectric grease to inside of boot.

I. Reconnect the spark plug wire or COP to the spark plug in the proper order.

Check Air Filter

A. Inspect the air filter reminder.

B. Record the reading on the gauge.

C. If the reading is in the red, replace filter, and reset the gauge.

D. If the reading has decreased significantly from the last reading, check for leaks, holes in the filter or leakage paths – replace/repair as necessary.

E. If filter minder is the same as last reading or higher but not in the red, leave filter in place.

F. After each air filter check, record and reset the gauge.

NOTE: Do not attempt to blow out, jar debris loose, or otherwise tap filter in an attempt to clean the filter.

Replace Engine Breather Filter (6.7LT and 10LNA)

A. Unscrew breather housing top counterclockwise.
B. Pull top of filter element up and remove filter.
C. Install new filter element and breather housing top.

Inspect Belts, Pipes, Clamps and Hoses

A. Inspect hoses, pipes, clamps, for loose connections, aging, corrosion, or leaks.
B. Check the belt for fraying or damage. Replace if necessary.
C. Look for fluid leaks under and around the engine.

Inspect Ignition System

A. Complete procedure #7 above, and also inspect coils for cracks, heat duress, and any damage.
B. Ensure all connections are secure.
C. Ensure the high-tension leads are routed around any heat sources, circuit boards or sharp objects that might damage the leads or if COP assure tight mounting.

Check Coolant Conditioner

A. When coolant is at room temperature or below, remove a sample of coolant and measure the levels of coolant additives with a test strip (applies to conventional coolants only).
B. Replace coolant or additive package if necessary or every two years. Ensure 50/50 mixture.
C. Remove thermostat &replace with new as needed or every two years during coolant change & flush.
D. Run engine until thermostat opens and allow engine to cool to inspect coolant level.
E. Reinstall radiator cap tightly.

Inspect Water Pump

A. Check the water pump and gasket for leak.
B. Inspect water pump weep holes for signs of leakage under pressure while pressure test cooling system.

Test and/or Replace Batteries (Minimum requirement: 750 Cold Cranking Amps)

A. Disconnect negative cables from batteries.
B. Disconnect positive cables from batteries.
C. Test each battery individually.
D. Remove old batteries (if necessary) and install new one (s).
E. Connect positive cables. Clean if required.
F. Connect negative cables. Clean if required.
G. Start engine and test alternator for proper operation.

Inspect Turbocharger (6.7L, 10L and 13L)

A. Remove coupling from turbocharger compressor inlet housing to gain access to the compressor wheel shaft.
B. Look for oil contamination.
C. Look for compressor wheel damage to blades.
D. Wiggle the shaft radially and axially to determine if there is excessive play in the turbo bearings.
E. If there is excessive play in the bearings or wear or damage, replace turbo.

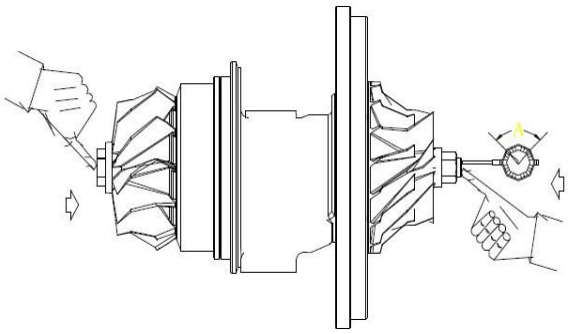


Illustration 40: Axial play

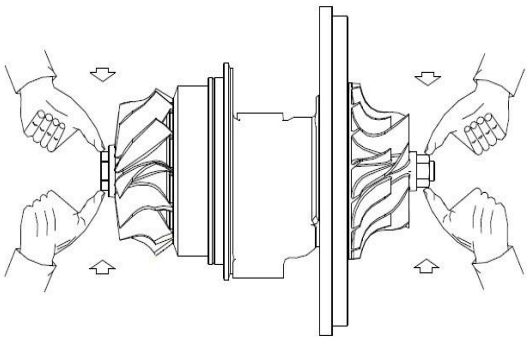


Illustration 41: Radial play

Maintenance for Long-Term Storage

Power Solutions International, Inc. runs all completed engines prior to shipping to customers.. Your engine can be stored Six (6) to twelve (12) months depending on humidity control in storage without any further service. Engines stored outdoors or in a high humidity environment may require more frequent treatment. All engine openings should be covered when you receive your engine. Please be sure to keep engine openings sealed during engine storage. In the event that your engine will be stored for extended times, you will need to follow recommended procedures for protecting your engine from rust.

No service to the cooling system should be required for engines stored less than one (1) year. If storing an engine for more than one year, remove thermostat(s), flush engine coolant passages with straight antifreeze solution, cover all openings, and return to storage.

Other procedures for storage:

- Fill or mix a preservative oil according to oil manufacturer's instructions. Mobilarma 524 or equivalent. Consult with your oil supplier for comparable products. Operate engine at high idle, no load until it reaches operating temperature in order to coat all surfaces with preservative oil solution.
- If engine is not runnable, crank for a maximum of 30 seconds with two-minute rests between cranking until all surfaces are coated. If unable to crank engine, bar engine over several times and use a spray to put preserving oil solution into the cylinders through spark plug holes, intake and exhaust ports, turbo inlet, etc. This will require a different mixture to penetrate and coat internal surfaces. Mobil Vaprotec Light or equivalent product. Consult with your oil supplier for comparable products.
- Clean the engine of dirt, rust, oil, water, etc. Inspect exterior and paint any areas required. Contact your Weichai America parts supplier for touch up Weichai blue paint.
- Brush or spray all unpainted steel or iron surfaces such as flywheels, gear teeth, and starter pinions, with a preserving solution. Mobilarma 247 or equivalent. Consult with your oil supplier for comparable products.
- Remove tension from all belts.
- Cover and seal all openings. Tag with date and procedure used to preserve.
- Cover engine but allow for air circulation to prevent condensation.
- Inspect periodically and reapply preservative oil solution if necessary.
- Follow preservative oil manufacturer's instructions for startup when removing engine from storage.

Engine Fastener Torque Specifications

4.5L

Fastener's Name	Bolt Specification	Tightening torque (N·m) + further turned angle (°)	Permissible times of repeat used
Main bearing*	M14-10.9	70N·m + (90±4°), required sequence of tightening (See illustration13)	2
Connecting rod*	M10	30N·m + (120±5°), (Reach 67 to 107N·m at the same time)	0
Cylinder head*	M14-12.9	30N·m +2x (120±4°), required sequence of tightening (See illustration14), (Reach 230 to 300N.m at the same time)	3
Flywheel housing*	10.9	M10-10.9: 80-85Nm; M12-10.9: 140-145Nm	
Flywheel*	M16-12.9	(290±5) N·m	2
Camshaft gear	M10/M8-12.9	M10: (85-90) N·m; M8: (55-60) N·m	2
Valve cover		(10-15) N·m	
Oil pan		(20-35) N·m	
Balance mechanism	4XM10	(35+5) N·m	
Intermediate gear		(65-70) N·m	
Exhaust manifold	M10	(65-80) N·m	
Intake manifold	M10	23 N.m	-
Crankshaft pulley	M16-12.9	(300-310) N·m	-
Damper	M10-10.9	(65-70) N·m	-
Rocker seat	M10-8.8	(40-45) N·m	-
Spark-plug	M14x1.25	(25-28) N·m	-
UEGO sensor	M18x1.5	(40±5) N·m	-
Water temperature sensor	M14x1.5	(25±5) N·m	-

① Values of superscript and subscript are permissible tolerance ranges
② The angle value is the further turned angle after reaching the specific torque
③ The number before the angle is the number of time to turn the angle
④ There are corresponding requirements on the strength classes of the bolts and nuts used at various positions of the engine. It is forbidden to interchange the bolts and nuts of the same size but of different strength classes. It is impermissible to exceed the allowed times of repeat use. Otherwise it will bring about severe outcome.
*It is required to apply oil on bolt spread and contact surface

Table 17

CAUTION

Failure to follow these instructions could cause damage or decrease the life of equipment.

Note in above Table 17 that connecting rod bolts cannot be re-used.

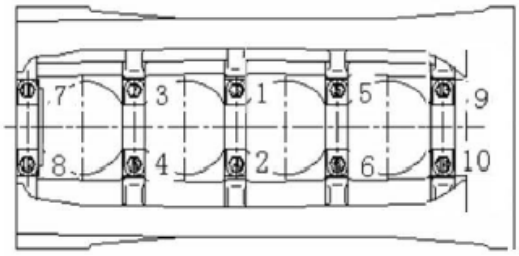


Illustration 42

Torque Head Bolts

NOTE:

Cylinder head bolts are allowed to be reused and torqued only three (3) times. Discard these bolts after the third torque because they lose their elasticity and strength and should not be torqued for a fourth time. Remove cylinder head covers.

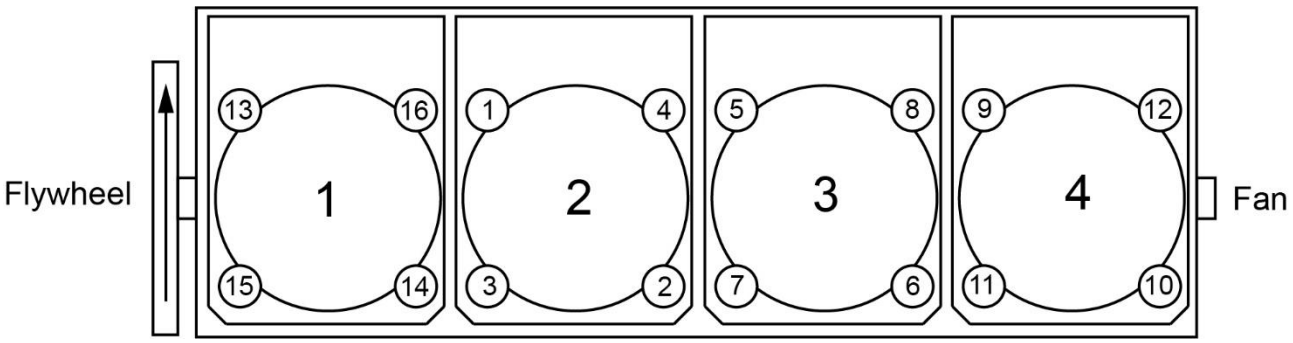


Illustration 43: Tighten order of cylinder head bolt

Tightening Process is as follows:

a. After lubricating the bolt and thread part, tighten the bolts to 30N·m; follow the order in Illustration 43.
b. Turn the bolt to 120±4°; follow the order in Illustration 43.
c. Turn the bolt to 120±4° again, and meanwhile the torque reaches 230 to 300N·m; follow the order in Illustration 43.

6.7L

Fastener's Name	Bolt Specification	Tightening torque (N·m) + further turned angle (°)	Permissible times of repeat used
Main bearing	M14-10.9	70N·m + (90±4°), required sequence of tightening (See illustration13)	2
Connecting rod (machine cut)	M12x1.5-12.9	30N·m + (60±4°), (Reach 85 to 135N·m at the same time)	0
Connecting rod (fracture split)	M10	30N·m + (120±5°), (Reach 67 to 107N·m at the same time)	0
Cylinder head	M14-12.9	30N·m +2x (120±4°), required sequence of tightening (See illustration14), (Reach 230 to 300N.m at the same time)	3
Flywheel	M16x10.9	290±5N·m	2
Camshaft gear	M8-12.9	55N.m+5N·m	2
Exhaust manifold	M10	45~60N·m	2
Intake manifold	M10	45~50N.m	-
Crankshaft pulley	M16-12.9	300~310N·m	-
Damper	M10-10.9	65~70N·m	-
Rocker seat	M10-8.8	40~45N·m	-
Spark-plug	M14x1.25	(25 to 28) N·m	-
UEGO sensor	M18x1.5	40N.m±5 N·m	-
Water temperature sensor	M14x1.5	25N.m±5 N·m	-

① Values of superscript and subscript are permissible tolerance ranges
② The angle value is the further turned angle after reaching the specific torque
③ The number before the angle is the number of time to turn the angle
④ There are corresponding requirements on the strength classes of the bolts and nuts used at various positions of the engine. It is forbidden to interchange the bolts and nuts of the same size but of different strength classes. It is impermissible to exceed the allowed times of repeat use. Otherwise it will bring about severe outcome.

Table 18

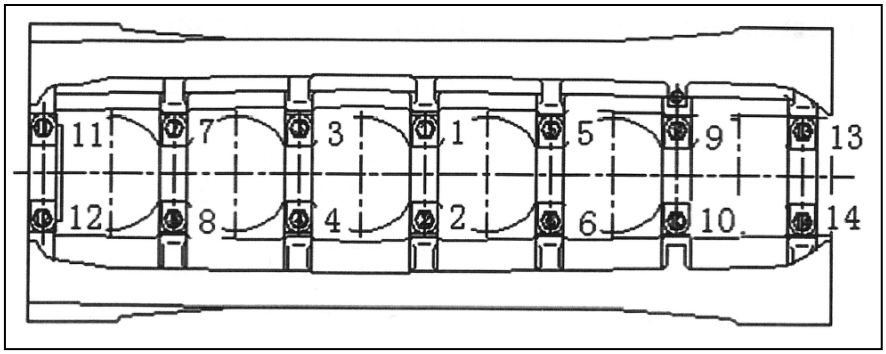


Illustration 44

CAUTION

Failure to follow these instructions could cause damage or decrease the life of equipment.

Note in above Table 18 that connecting rod bolts cannot be re-used.

Torque Head Bolts

NOTE:

Cylinder head bolts are allowed to be reused and torqued only three (3) times. Discard these bolts after the third torque because they lose their elasticity and strength and should not be torqued for a fourth time. Remove cylinder head covers.

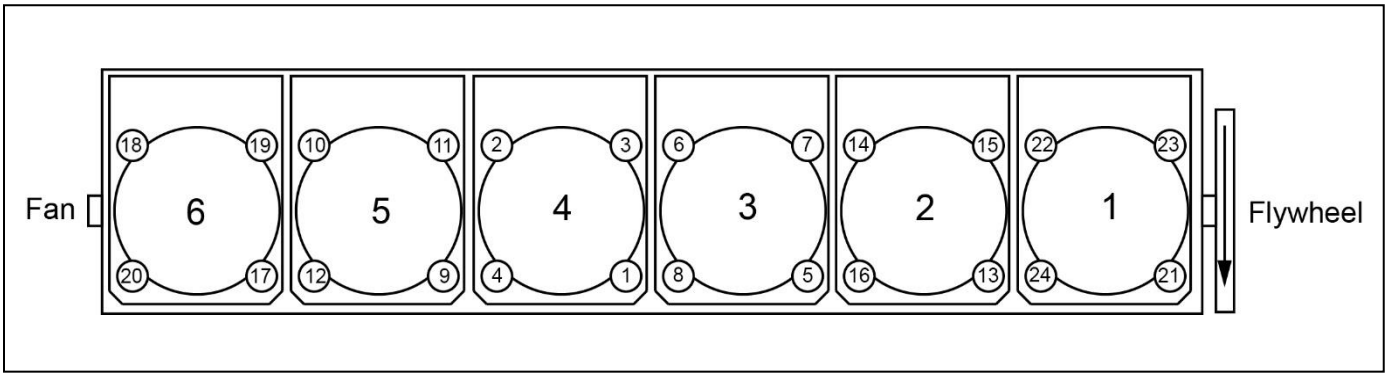


Illustration 45: Tighten order of cylinder head bolt

Tightening Process is as follows:

a. After lubricating bolt and thread part, tighten the bolts to 30N·m; follow he order in Illustration 45.

b. Turn the bolt to 120±4°; follow the order in Illustration 45.

c. Turn the bolt to 120±4° again, and meanwhile the torque reaches to 230 to 300N·m; follow the order in Illustration 45.

10L

Fastener's Name	Bolt Specification	Tightening torque (N·m) + further turned angle (°)	Permissible times of repeat used
Main bearing	M18-10.9	The first time 80N·m, the second time 250~280N·m (See illustration13)	2
Connecting rod	M14x1.5-12.9	120N·m + (90±5°), (Reach 170 to 250N·m at the same time)	0
Cylinder head	M16-12.9	200N·m +2x (90±5°), required sequence of tightening (See illustration14), (Reach 240 to 340N.m at the same time)	3
Flywheel	M14x1.5	60N·m +2x(90±5°), (Reach 230 to 280N·m at the same time)	2
Flywheel housing		110 to 140N·m	2
Camshaft gear	M8-12.9	40 to 45N·m	
Exhaust manifold	M10	50 to 70N·m	2
Intake manifold	M10	45+5N.m	-
Damper	M10-10.9	65 to 70N·m	-
Spark-plug	M14x1.25	(25 to 28) N·m	-
UEGO sensor	M18x1.5	40N.m±5N·m	-
Water temperature sensor	M14x1.5	25N.m±5N·m	-

① Values of superscript and subscript are permissible tolerance ranges
② The angle value is the further turned angle after reaching the specific torque
③ The number before the angle is the number of time to turn the angle
④ There are corresponding requirements on the strength classes of the bolts and nuts used at various positions of the engine. It is forbidden to interchange the bolts and nuts of the same size but of different strength classes. It is impermissible to exceed the allowed times of repeat use. Otherwise, it will bring about severe outcome.

Table 19

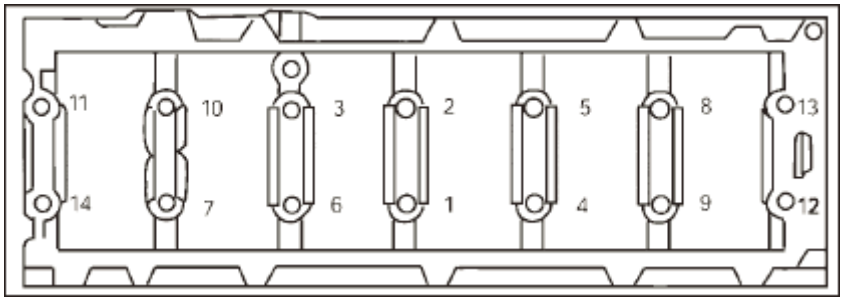


Illustration 46

CAUTION

Failure to follow these instructions could cause damage or decrease the life of equipment.

Note in above Table 19 that connecting rod bolts cannot be re-used.

Torque Head Bolts and Nuts

NOTE: Cylinder head bolts are allowed to be reused and torqued only three (3) times. Discard these bolts after the third torque because they lose their elasticity and strength and should not be torqued for a fourth time. Remove cylinder head covers.

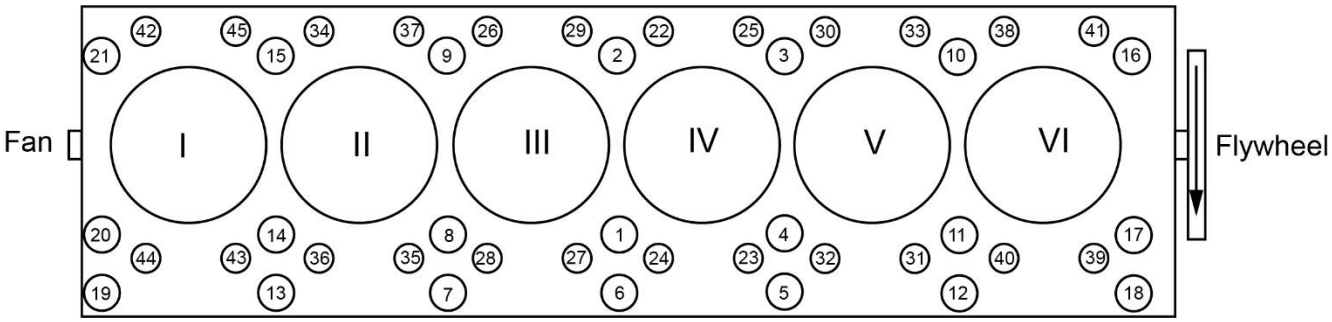


Illustration 47: Tighten order of cylinder head bolts and nuts

Tightening Process is as follows:

a. Align the cylinder head with the cylinder block. Apply a proper amount of clean lubricating oil to the threads and pressure-bearing surfaces of shoulders of the main bolts of cylinder head and the shouldered nuts. Install the main bolts to the cylinder head. Install the clamping blocks and nuts to the auxiliary bolts of cylinder head.

b. Tighten the main bolts and nuts of auxiliary bolts of cylinder head to the torque of (30~50) Nm.

c. Tap the clamping blocks so that they fall in place.

d. Tighten the nuts of auxiliary bolts in the specified sequence to the torque of 100N·m.

e. Tighten the main bolts in the specified sequence to the torque of 200N·m.

f. Tighten the nuts of auxiliary bolts in the specified sequence by 90º. Then make marks on the nuts.

g. Tighten the main bolts in the specified sequence by 90º. Then make marks on the bolts.

h. Tighten the nuts of auxiliary bolts in the specified sequence by another 90º to the torque of (120~160) Nm.

i. Tighten the main bolts in the specified sequence by another 90º to the torque of (240~340) Nm.

j. The cylinder head bolts and nuts shall be tightened according to the order given by Illustration 47, in which, those numbering 1-21 are nuts of auxiliary bolt, while those numbering 22-45 are main bolts of cylinder head.

13L

Fastener's Name	Bolt Specification	Tightening torque (N·m) + further turned angle (°)	Permissible times of repeat used
Main bearing	M18-10.9	The first time 80N·m, the second time 140N·m the third time turn 90°, the last time turn 60°	2
Connecting rod	M14x1.25	115N·m + (90±5°), (Reach 200 to 290N·m at the same time)	0
Cylinder head	M14x2	60N·m +2x (120±5°), required sequence of tightening (See illustration14)	3
Flywheel	M16x1.5-10.9	105N·m +2x(90±5°)	2
Crankshaft pulley	M12x1.5	45N.m +135º	2
Damper	M10-10.9	60~70N·m	-
Spark-plug	M14x1.25	(25 to 28) N·m	-
UEGO sensor	M18x1.5	50N.m±5N·m	-
Water temperature sensor	M14x1.5	25N.m±5N·m	-

① Values of superscript and subscript are permissible tolerance ranges
② The angle value is the further turned angle after reaching the specific torque
③ The number before the angle is the number of time to turn the angle
④ There are corresponding requirements on the strength classes of the bolts and nuts used at various positions of the engine. It is forbidden to interchange the bolts and nuts of the same size but of different strength classes. It is impermissible to exceed the allowed times of repeat use. Otherwise it will bring about severe outcome.

Table 20

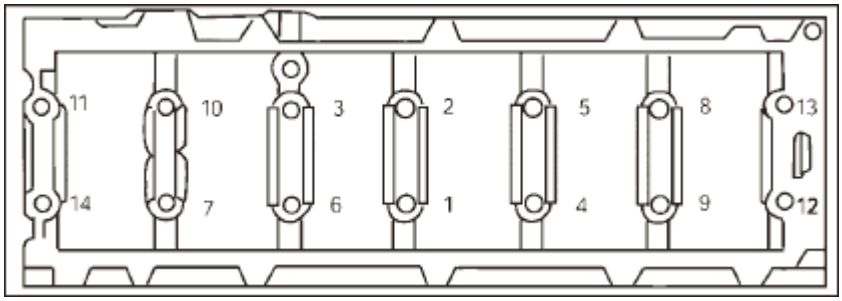


Illustration 48

CAUTION

Failure to follow these instructions could cause damage or decrease the life of equipment.

Note in above Table 20 that connecting rod bolts cannot be re-used.

Torque Head Bolts and Nuts

NOTE:

Cylinder head bolts are allowed to be reused and torqued only three (3) times. Discard these bolts after the third torque because they lose their elasticity and strength and should not be torqued for a fourth time. Remove cylinder head covers.

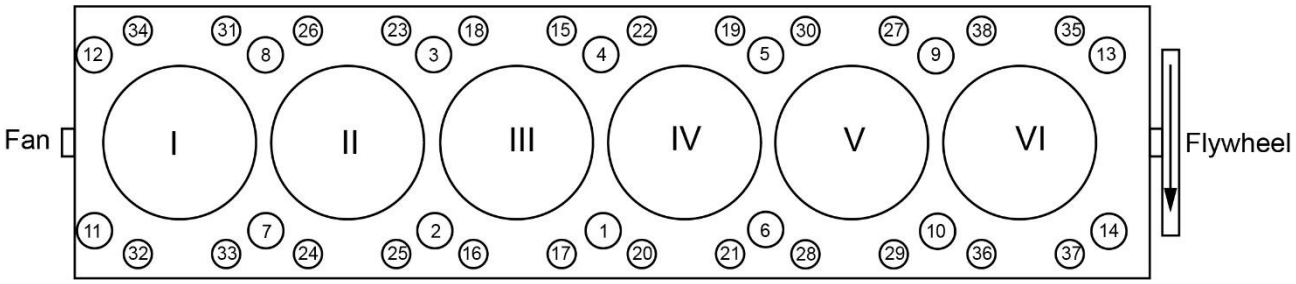


Illustration 49: Tighten order of cylinder head bolts and nuts.

Tightening Process is as follows:

A. Align the cylinder head with the cylinder block. Apply a proper amount of clean lubricating oil to the threads and pressure-bearing surfaces of shoulders of the main bolts of cylinder head and the shouldered nuts. Install the main bolts to the cylinder head. Install the clamping blocks and nuts to the auxiliary bolts of cylinder head.

B. Tighten the main bolts in the specified sequence to the torque of 60±6Nm.

C. Tighten the nuts of auxiliary bolts in the specified sequence to the torque of 25±3Nm.

D. Tighten the nuts of auxiliary bolts in the specified sequence by 120º±5º. Then make marks on the nuts.

E. Tighten the main bolts in the specified sequence by 120º±5º. Then make marks on the bolts.

F. Tighten the nuts of auxiliary bolts in the specified sequence by another 120º±5º.

G. Tighten the main bolts in the specified sequence by another 120º±5º.

H. The cylinder head bolts and nuts shall be tightened according to the order given by Illustration 49, in which, those numbering 1-14 are nuts of auxiliary bolt, while those numbering 15-38 are main bolts of cylinder head.

	0.125 (Galvanized)				0.14 (Bright)			
Strength Class	6.9	8.8	10.9	12.9	6.9	8.8	10.9	12.9
Bolt Specs	**Recommended Torque (N·m)**							
M4	2.3	2.7	3.8	4.6	2.4	2.9	4.1	4.9
M5	4.7	5.5	8.0	9.5	5.0	6.0	8.5	10
M6	8.0	9.5	13.0	16.0	8.5	10	14.0	17
M8	19	23	32	39	21	25	35	41
M10	39	46	64	77	41	49	69	83
M12	67	80	110	135	72	86	120	145
M14	105	125	180	215	115	135	190	230
M16	165	195	275	330	180	210	295	355
M18	225	270	390	455	245	290	405	485
M20	325	385	540	650	345	410	580	690
M22	435	510	720	870	465	550	780	930
M24	560	660	930	1100	600	710	1000	1200
M27	830	980	1400	1650	890	1050	1500	1800
M30	1100	1350	1850	2250	1200	1450	2000	2400
M8x1	21	25	35	42	23	27	38	45
M10x1.25	41	49	66	82	44	52	73	88
M12x1.25	74	88	125	150	80	95	135	155
M12x1.5	70	83	115	140	76	90	125	150
M14x1.5	115	140	195	235	125	150	210	250
M16x1.5	175	210	295	350	190	225	315	380
M18x1.5	255	305	425	510	275	325	460	550
M20x1.5	360	425	600	720	385	460	640	770
M22x1.5	480	570	800	960	520	610	860	1050
M24x1.5	610	720	1000	1200	650	780	1100	1300
M27x1.5	890	1050	1500	1800	970	1150	1600	1950
M30x1.5	1250	1450	2050	2500	1350	1600	2250	2700

Table 21

Engine Service Schedule Log

Service Interval (hr.)	Service Date	Start Time	Complete Time	Hour Meter	Comments	Initial
50						
500						
1000						
1500						
2000						
2500						
3000						
3500						
4000						
4500						
5000						
5500						
6000						
6500						
7000						
7500						
8000						
8500						
9000						

Engine Identification

Engine Part Number: _____

Engine Serial Number:

Engine Application: _____

Purchased From: _____

In-Service Date: _____

Engine Hours at Delivery: _____

PM INSPECTION Performed by: _____

UNIT #_____ DATE: _____HOURS: _____

WORK ORDER#_____

PM TYPE: ☐____ hr.☐_____ mo/yr Codes: ☑ OK ☐ Needs Follow Up ☒ Adjustment Made

ENGINE COMPARTMENT INSPECTION

CHECK ENGINE OIL LEVEL		REPLACE BREATHER FILTER	
CHECK ENGINE COOLANT LEVEL		INSPECT BELTS, PIPES, CLAMPS & HOSES	
CHECK OIL PRESSURE		IGNITION SYSTEM (PLUG WIRES/COILS/COP)	
CHECK OVERALL OPERATING CONDITION		CHECK COOLANT CONDITIONER (SAMPLE) REPLACE COOLANT AS REQUIRED	
CHANGE OIL & OIL FILTER (SAMPLE)		INSPECT WATER PUMP	
ADJUST VALVE LASH		TEST BATTERY & ALTERNATOR	
SPARK PLUGS (CHECK/ADJUST/REPLACE)		INSPECT TURBOCHARGER	
CHECK AIR FILTER (INSPECT/REPLACE)			

NOTES

1. _____
2. _____
3. _____
4. _____
5. _____

6.

7.

8.

9.

10.

11.

12.

13.

14.

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