Doosan Forklift Service Manual G420fe Lpdual G420f Lpgasoline Dual Fuel Engine
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SB4241E00
Apr. 2007

Service Manual

G420FE LP/Dual Fuel Engine
G420F LP/Gasoline Dual Fuel Engine

G15S-5, G18S-5, G20SC-5
GC15S-5, GC18S-5, GC20SC-5
G20E-5, G25E-5, G30E-5
GC20E-5, GC25E-5, GC30E-5, GC33E-5

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Important Safety Information

Most accidents involving product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Read and understand all safety precautions and warnings before operating or performing lubrication, maintenance and repair on this product.

Basic safety precautions are listed in the “Safety” section of the Service or Technical Manual. Additional safety precautions are listed in the “Safety” section of the owner/operation/maintenance publication.
Specific safety warnings for all these publications are provided in the description of operations where hazards exist. WARNING labels have also been put on the product to provide instructions and to identify specific hazards. If these hazard warnings are not heeded, bodily injury or death could occur to you or other persons. Warnings in this publication and on the product labels are identified by the following symbol.

⚠ WARNING

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.
Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Operations that may cause product damage are identified by NOTICE labels on the product and in this publication.

DOOSAN cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are therefore not all inclusive. If a tool, procedure, work method or operating technique not specifically recommended by DOOSAN is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance or repair procedures you choose.

The information, specifications, and illustrations in this publication are on the basis of information available at the time it was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before starting any job. DOOSAN dealers have the most current information available.

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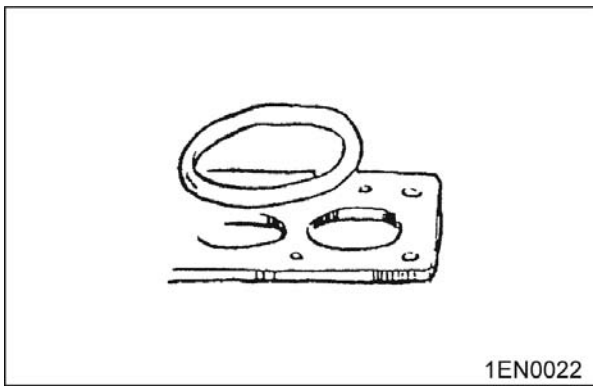
Chapter 1. GENERAL INFORMATION

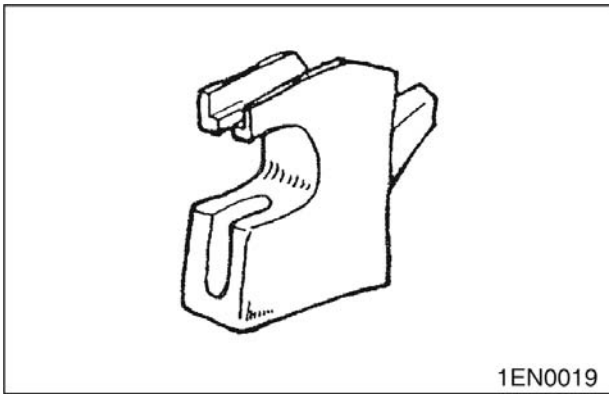
Precautions before Service

Removal and Disassembly



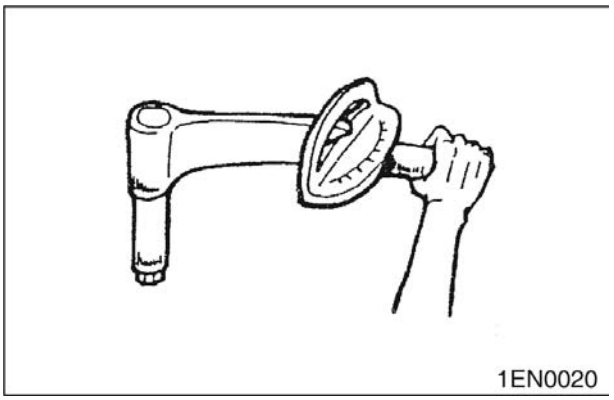
For prevention of wrong installation or reassembly and for ease of operation, put mating marks to the parts where no function is adversely affected.

Special Tool



Be sure to use Special Tools when their use is specified for the operation.
Use of substitute tools will result in malfunction of the part or damage it.

Tightening Torque

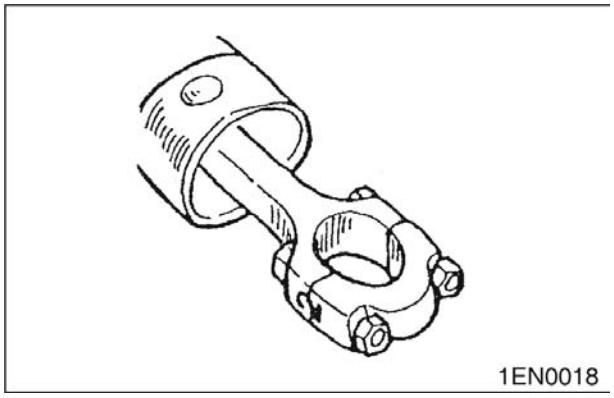


Tighten the part properly to specified torque.

Sealant

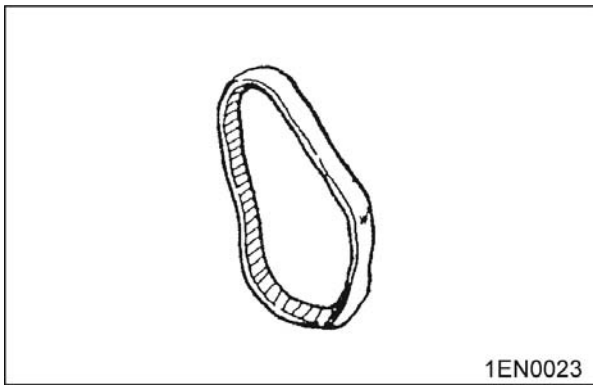
Use specified brand of sealant.
Use of sealant other than specified sealant may cause water or oil leaks.

Replacement Part



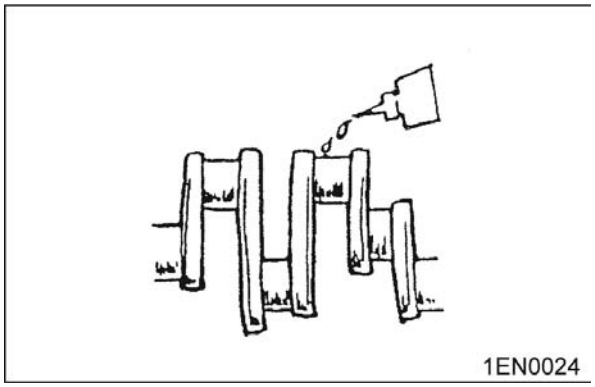
When oil seal, O-ring, packing and gasket have been removed, be sure to replace them with new parts.
However, rocker cover gasket may be reused if it is not damaged.

Rubber Parts



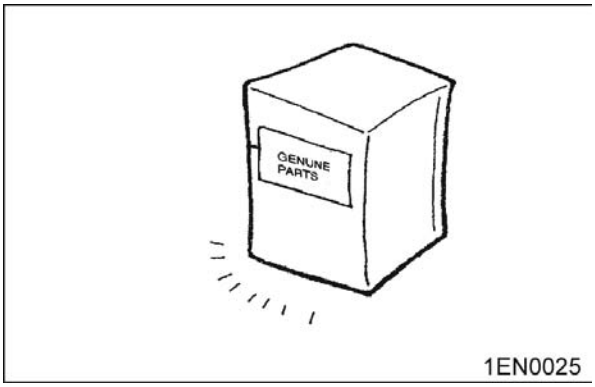
Do not stain timing belt and V-belt with oil or water. Therefore, do not clean the pulley and sprocket with detergent.

Oil and Grease



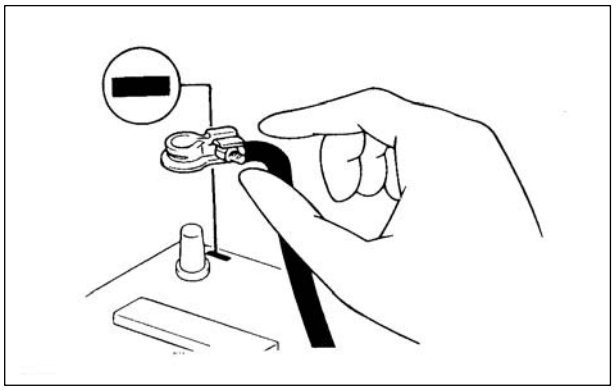
Before reassembly, apply specified oil to the rotating and sliding parts.

Genuine Part



When the part is to be replaced, be sure to use genuine part.
For selection of appropriate parts, refer to the Parts Catalog.

Electrical System



1. Be sure to disconnect the battery cable from the negative(-) terminal of the battery.

2. Never pull on the wires when disconnecting connectors.

3. Locking connectors will click when the connector is secure.

4. Handle sensors and relays carefully. Be careful not to drop them or hit them against other parts.

Precautions for catalytic Converter

⚠ CAUTION

If a large amount of unburned gasoline flows into the converter, it may overheat and create a fire hazard. To prevent this, observe the following precautions and explain them to your customer.

1. Use only unleaded gasoline.

2. Do net run the engine while the truck is at rest for a long time. Avoid running the engine at fast idle for more than 5 minutes and at idle speed for more than 10 minutes.

3. Avoid spark-jump tests. Do spark-jumps only when absolutely necessary. Perform this test as rapidly as possible and, while testing, never race the engine.

4. Do not measure engine compression for an extended time. Engine compression tests must be made as rapidly as possible

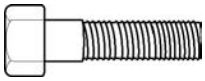
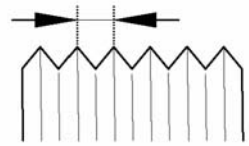
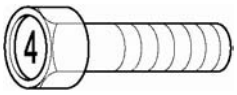
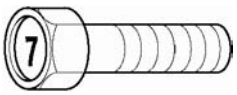
5. Do not run the engine when the fuel tank is nearly empty. This may cause the engine to misfire and create and extra load on the converter.

6. Avoid coasting with the ignition turned off and during prolonged braking

7. Do not dispose of a used catalytic converter together with parts contaminated with gasoline or oil.

Tightening Torque

Tightening Torque Table of Standard Parts

Bolt nominal diameter(mm)	Pitch(mm)	Torque (kg·m)	
		Head mark 4	Head mark 7
			
M5	0.8	0.3 ~ 0.4	0.5 ~ 0.6
M6	1.0	0.5 ~ 0.6	0.9 ~ 1.1
M8	1.25	1.2 ~ 1.5	2.0 ~ 2.5
M10	1.25	2.5 ~ 3.0	4.0 ~ 5.0
M12	1.25	3.5 ~ 4.5	6 ~ 8
M14	1.2	7.5 ~ 8.5	12 ~ 14
M16	1.5	11 ~ 13	18 ~ 21
M18	1.5	16 ~ 18	26 ~ 30
M20	1.5	22 ~ 25	36 ~ 42
M22	1.5	29 ~ 33	48 ~ 55
M24	1.5	37 ~ 42	61 ~ 70
M5	0.8	0.3 ~ 0.4	0.5 ~ 0.6
M6	1.0	0.5 ~ 0.6	0.9 ~ 1.1
M8	1.25	1.2 ~ 1.5	2.0 ~ 2.5
M10	1.25	2.5 ~ 3.0	4.0 ~ 5.0

NOTE: The torques shown in the table are standard vales under the following conditions.

1. Nuts and bolt are made of steel bar and galvanized.

2. Galvanized plain steel washers are inserted.

3. All nuts, bolts, plain washers are dry.

NOTE: The torques shown in the table are not applicable,

1. When spring washers, toothed washers and the like are inserted.

2. If plastic parts are fastened.

3. If oil is applied to threads and surfaces.

NOTE: If you reduce the torques in the table to the percentage indicated below under the following conditions, it will be the standard value.

1. If spring washers are used : 85%

2. If threads and bearing surfaces are stained with oil: 85%

Recommended Lubricants and Capacities

Recommended Lubricants

Lubricant	Specification	Remarks
Engine Oil	API Classification SJ or above	SAE 10W30 or SAE 5W30
Coolant (Antifreeze)	Automotive antifreeze suitable for gasoline engines having aluminum alloy parts	Concentration level 50%(normal) Concentration level 40%(tropical)

Lubricant Capacities

Description		G(C)18S-5, G(C)20SC-5	G(C)20/25/30E-5
Engine Oil (liters)	Oil Pan	3.7	3.7
	Oil Filter	0.3	0.3
	Total	4.0	4.0
Coolant (liters)	Engine	3.0	3.0
	Radiator & Hoses	5.5	5.5
	Total	8.5	8.5

Engine Model and Engine Serial Number

Engine Model	Fuel Type	Emission Regulation
G420FE	LP/Dual Fuel	EPA/CARB* 2007 Compliant
G420F	LP/Gasoline/Dual Fuel	

* EPA: Environmental Protection Agency

* CARB: California Air Resources Board

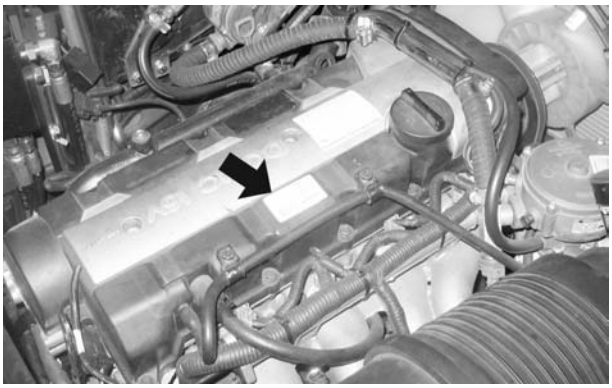
G420FE Engine

- Comply with EPA 2007 Emission Regulation
- Electronic Control by ECM
- Certified LP/Dual Fuel System available
  - Closed loop LP Carburetion system
  - Closed loop MPI Gasoline system
- 3-way Catalytic Muffler is standard

G420F Engine

- Not comply with EPA 2007 Emission Regulation
- Electronic Control by ECM
- Standard LP/Gas/DF/Dual Fuel System available
  - Open loop LP Carburetion system
  - Closed loop MPI Gasoline system
- Muffler is standard

Indication of Engine Model and Serial Number



Engine Model	Engine Serial Number
G420FE/G420F	30700001 to 39999999

Features and Benefits of G420FE/G420F Engine

- Al head with valve seat inserts
  - Aluminum head and valve seat system
- DOHC 16 valve system
- Durable timing belt system
  - Durable timing belt material and rubber-sealed cover
- Distributorless Ignition system (coil on plug)
- Electronic control system by ECM (Engine control module)
  - Drive-by-wire system
  - Higher efficiency and lower fuel consumption
  - Min./Max. governor control
  - Automatic engine protection from overheating and/or low engine oil pressure
  - Automatic transmission protection from overheating
  - Engine diagnostics by service-tool software
  - Forklift ground speed limit (optional)

General Specification

	G420FE Engine	G420F Engine
GENERAL DESCRIPTION		
ENGINE TYPE:	Water-cooled, Inline 4-Cycle, 4-Cylinders	
COMBUSTION SYSTEM:	Semi-Rent Roof	
INTAKE MANIFOLD	Cast Aluminum (with injector ports)	
EXHAUST MANIFOLD	Cast Iron, Dry	
VALVE CONFIGURATION:	DOHC, 4 Valves per Cylinder	
VALVE LIFTER/LASH ADJUSTER	Hydraulic Lash Adjuster	
VALVE ROTATOR	Intake/Exhaust Rotator	
CAMSHAFT DRIVE	Timing belt system (25.4 mm Toothed Belt)	
DISPLACEMENT:	1,975 cc (120.5 cid)	
BORE x STROKE	82mm (3.23 in) x 93.5 mm (3.68 in)	
BLOCK STRUCTURE	Grey Cast Iron	
HEAD STRUCTURE	Aluminum with seat inserts	
COMPRESSION RATIO:	9.4:1	
COMPRESSION PRESSURE:	1,450 kPa (210 psi)	
VALVE TIMING:	Intake Valve: 2° BTDC(Open)/ 16° ABDC(Close)	
	Exhaust Valve: 6° BBDC(Open)/ 2° ATDC(Close)	
FIRING ORDER:	1-3-4-2	
WEIGHT:	170 kg (Dry)	
ENGINE ROTATION:	Counter-Clockwise (CCW) when viewed from Flywheel End	
FUEL TYPE:	LPG, Gasoline, Dual Fuel (LPG or Gasoline)	
CRANK VENTILATION	Foul Air System with PCV	
IGNTION SYSTEM		
IGNITION TYPE:	Distributorless (coil on plug)	
IGNITION TIMING:	Electronic controlled by ECM	
POWER TRANSISTOR	Ignition coil driver	
IGNITION COIL:	12 V operation volt, 4 coils (coil on plug)	
SPARK PLUGS:	Platimum Spark Plug (Air Gap: 0.8mm)	
LUBRICATION SYSTEM		
OIL PRESSURE:	167 kPa (24 psi) @ low Idle (90-100C oil temperature)	
OIL TEMPERATURE:	Upper Limit: 125°C (257°F)	
	Recommended: 99 - 110°C (210 - 230°F)	
	Lower Limit:80°C (176°F)	
OIL PAN	Cast Aluminum	
OIL PAN CAPACITY	3.7 L (EXCLUDES OIL FILTER)	
OIL FILTER:	0.3 L	
ENGINE OIL SPECIFICATION:	API - SJ, SAE 10W30 or SAE 5W30	
COOLING SYSTEM		
WATER PUMP ROTATION:	V-Belt Drive - Clockwise (CW) when viewed from engine front	
THERMOSTAT:	Opening Temperature: 82°C (180°F)	
	Fully Open Temperature: 95°C (203°F)	
COOLING WATER CAPACITY:	3.0 L (block only)	

General Specification

	G420FE Engine	G420F Engine
LP FUEL SYSTEM		
LP FUEL SYSTEM	Closed loop LP Carburetion System	Open loop LP Carburetion System
MIXER:	Diaphragm Type Air Valve Assembly inside, Downdraft (Model: CA-100)	Diaphragm Type Air Valve Assembly inside, Downdraft (Model: CA-100)
REGULATOR:	Two-Stage Negative Pressure Regulator (Model: N-2007)	Two-Stage Negative Pressure Regulator (Model: N-2001)
FUEL TRIM VALVE (FTV):	Dual Dither System	No FTV
FUEL FILTRATION:	40 Microns Maximum	40 Microns Maximum
GASOLINE FUEL SYSTEM		
GASOLINE FUEL SYSTEM	Closed loop MPI System and In-Tank Fuel Pump System	
FUEL PUMP MODULE	Electric Fuel Pump (12V)	
	Fuel Filter & Strainer	
	Gasoline Pressure Regulator (3.5 bar)	
FUEL INJECTOR ASS'Y	Electric Fuel Injector (12V)	
ENGINE ELECTRIC		
ENGINE CONTROL MODULE(ECM):	12 V operation volt, 48 pins of I/O	
CRANK SENSOR	Magnetic Inductive type	
CAM SENSOR	Hall sensor	
TMAP:	Intake Air Temp. & Manifold Absolute Press. Sensor	
PEDAL ANGLE SENSOR:	Two-Output Signals (built in Accelerator Pedal)	
OXYGEN SENSOR:	Dual Oxygen Sensor System	Gasoline : One Oxygen sensor LPG: No Oxygen sensor
ECT-ECM:	Engine Coolant Temperature Sensor for ECM	
ECT-GAUGE	Engine Coolant Temp. Sensor for GAUGE on Instrument Panel	
TPS:	Throttle Position Sensor (built in Throttle Body)	
THROTTLE BODY:	Electronic Throttle Body	
LP FUEL LOCK-OFF:	12 V operation volt	
ENGINE OIL PR. S/W:	28.4 kPa (4.1 psi)	
STARTING MOTOR:	12 Volts, 1.7 kW	
ALTERNATOR:	13.5 Volts, 90 Amp	
EXHAUST SYSTEM		
Muffler	Catalytic Muffler	Muffler (without catalyst)

Engine Power and Torque

G420FE Engine Power & Torque

FORKLIFT MODEL		G(C)15/18S-5	G(C)20/25/30E-5	
ENGINE MODEL		G420FE-LP	G420FE-DF(LP) & G420FE-LP	G420FE-DF(Gas)
RATED POWER	Kw	33.6	39.5	39.5
	hp	45	53	53
	PS	46	54	54
	rpm	2,400	2,550	2,550
MAX TORQUE	N-m	147	157	157
	lbf-ft	108	116	116
	kgf-m	15,0	16.0	16.0
	rpm	1600	1600	1600
GOVERNED SPEED	rpm	2450	2600	2600
LOW IDLE	rpm	750	750	750

G420F Engine Power & Torque

FORKLIFT MODEL		G(C)15/18S-5		
ENGINE MODEL		G420F-DF(LP) & G420F-LP	G420F-DF(Gas)	G420F-GAS
RATED POWER	Kw	33.6	35.8	36.5
	hp	45	48	49
	PS	45.6	48.7	49.7
	rpm	2,400	2,400	2,400
MAX TORQUE	N-m	147	152	154
	lbf-ft	108	112	114
	kgf-m	15,0	15.5	15.7
	rpm	1600	1600	1600
GOVERNED SPEED	rpm	2450	2450	2450
LOW IDLE	rpm	750	750	750

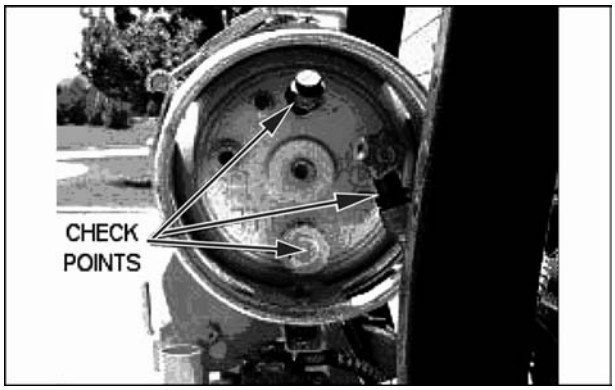
FORKLIFT MODEL		G(C)20/25/30E-5		
ENGINE MODEL		G420F-DF(LP) & G420F-LP	G420F-DF(Gas)	G420F-GAS
RATED POWER	Kw	39.5	39.5	40.3
	hp	53	53	54
	PS	53.7	53.7	54.7
	rpm	2,550	2,550	2,550
MAX TORQUE	N-m	157	157	160
	lbf-ft	116	116	118
	kgf-m	16.0	16.0	16.3
	rpm	1600	1600	1600
GOVERNED SPEED	rpm	2600	2600	2600
LOW IDLE	rpm	750	750	750

Chapter 2. RECOMMENDED MAINTENANCE

Suggested maintenance requirements for an engine equipped with an MI-07 fuel system are contained in this section. The operator should, however, develop a customized maintenance schedule using the requirements listed in this section and any other requirements listed by the engine manufacturer.

General Maintenance

Test Fuel System for Leaks



- Obtain a leak check squirt bottle or pump spray bottle.
- Fill the bottle with an approved leak check solution.
- Spray a generous amount of the solution on the fuel system fuel lines and connections, starting at the storage container.
- Wait approximately 15-60 seconds, then perform a visual inspection of the fuel system. Leaks will cause the solution to bubble.
- Listen for leaks
- Smell for LPG odor which may indicate a leak
- Repair any leaks before continuing.
- Crank the engine through several revolutions. This will energize the fuel lock-off and allow fuel to flow to the pressure regulator/converter. Apply additional leak check solution to the regulator/ converter fuel connections and housing. Repeat leak inspection as listed above.
- Repair any fuel leaks before continuing.

Inspect Engine for Fluid Leaks

- Start the engine and allow it to reach operating temperatures.
- Turn the engine off.
- Inspect the entire engine for oil and/or coolant leaks.
- Repair as necessary before continuing.

Inspect Vacuum Lines and Fittings

- Visually inspect vacuum lines and fittings for physical damage such as brittleness, cracks and kinks. Repair/replace as required.
- Solvent or oil damage may cause vacuum lines to become soft, resulting in a collapsed line while the engine is running.
- If abnormally soft lines are detected, replace as necessary.

Inspect Electrical System

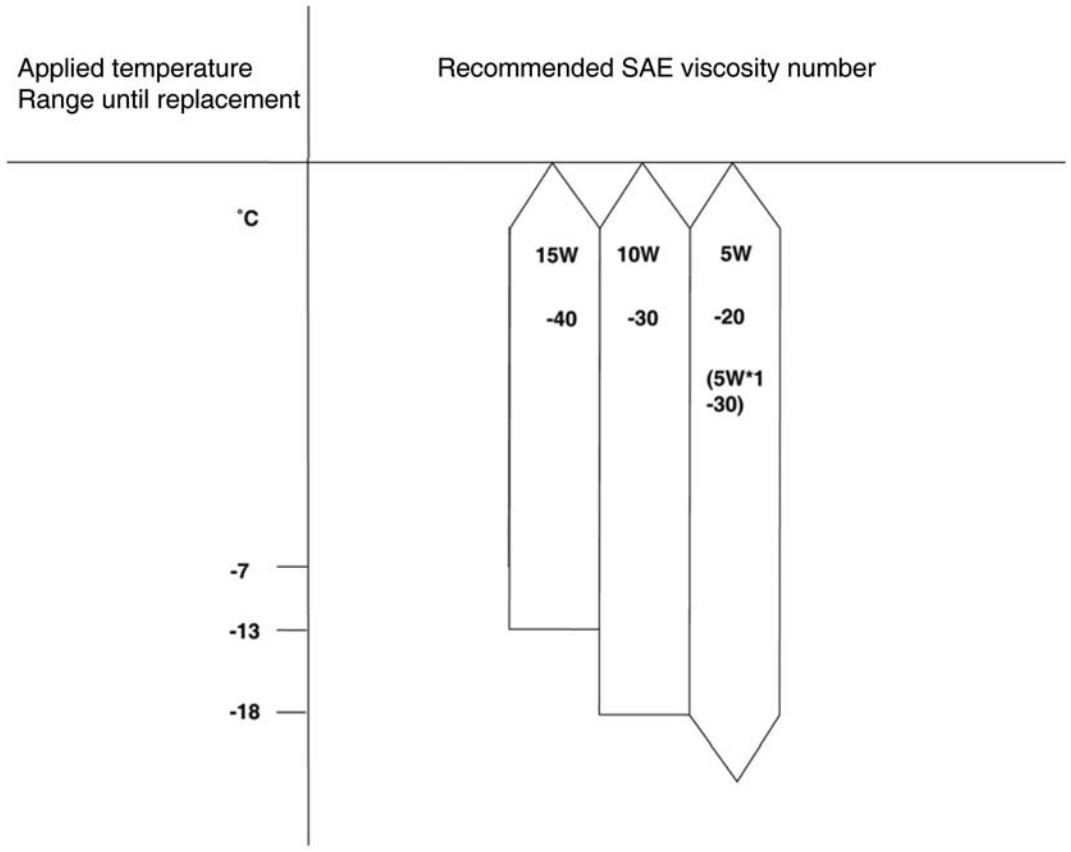
- Check for loose, dirty or damaged connectors and wires on the harness including: fuel lock-off, TMAP sensor, O2 sensors, electronic throttle, control relays, fuel trim valves, crank position sensor, and cam position sensor.
- Repair and/or replace as necessary.

Inspect Foot Pedal Operation

- Verify foot pedal travel is smooth without sticking.

Engine Oil Classification

Recommended API classification: Above SJ
Recommended SAE viscosity classification



*1. 10W-30 engine oil is recommended
If 10W-30 is not applicable, proper engine oil will be possible according to temperature ranges.

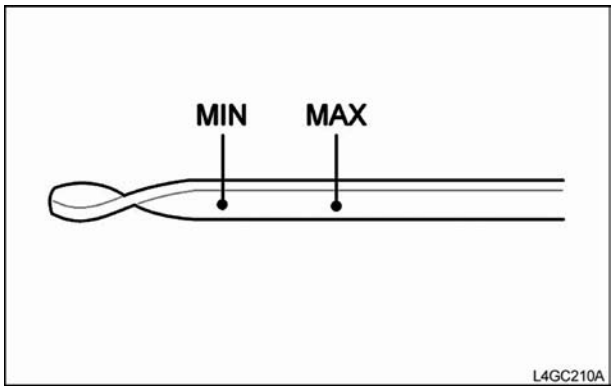
L4GC209A

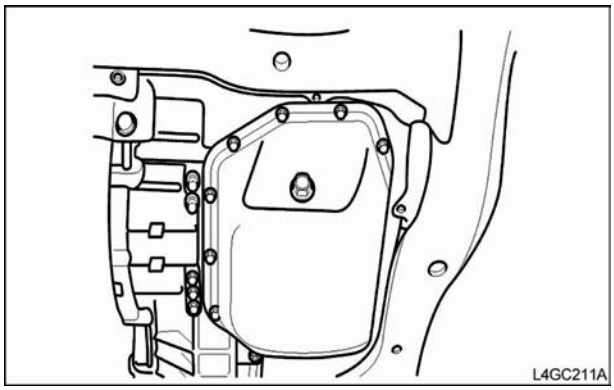
The following lubricants should be selected for all engines to enhance excellent performance and maximum effect.

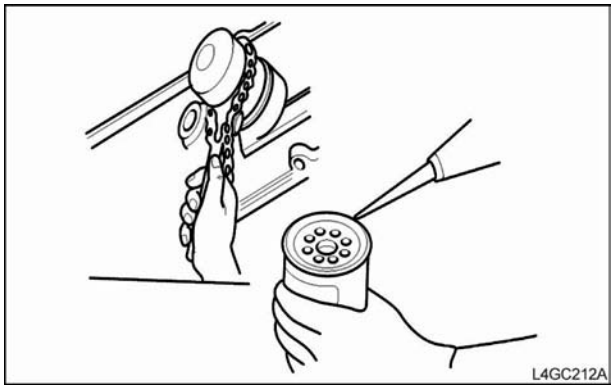
1. Observe the API classification guide.

2. Proper SAE classification number should be selected within ambient temperature ranges. Do not use the lubricant with SAE classification number and API grade not identified on the container.

Checking Engine Oil Level







1. Check that the oil level is between “MIN” and “Max” marks on the engine oil level gauge.

2. If the oil level is below “MIN” mark, add oil until the level is within the specified ranges.

3. Check the engine for oil contamination and viscosity and replace if necessary.

Replacing Engine Oil and Filter

⚠ CAUTION

Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.

1. Drain engine oil.

1) Remove the oil filler cap.

2) Remove the oil drain plug, and drain the oil into a container.

2. Replace oil filter.

1) Remove the oil filter.

2) Check and clean the oil filter installation surface.

3) Check the part number of the new oil filter is as same as old one.

4) Apply clean engine oil to the gasket of a new oil filter.

5) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.

6) Tighten it an additional 3/4 turn.

3. Refill with engine oil filter.

1) Clean and install the oil drain plug with a new gasket.

Torque	39.2~44.1N.m(4.0~4.5kgf.m, 28.9~32.5lb-ft)

2)Fill with fresh engine oil.

Capacity Drain and refill	4.0L(4.23US qts, 3.52Lmp qts)
Oil filter	0.3L(0.32US qts, 0.26Lmp qts)

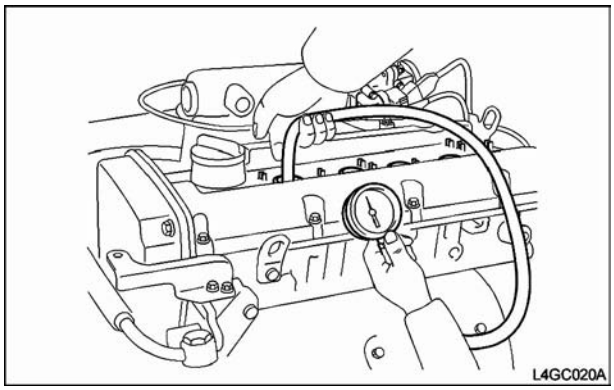
Doosan Forklift Service Manual G420fe Lpdual G420f Lpgasoline Dual Fuel Engine
Full download: http://manualplace.com/download/doosan-forklift-service-manual-g420fe-lpdual-g420f-lpgasoline-dual-fuel-en

3) Install the oil filler cap.

4. Start engine and check for oil leaks.

5. Recheck engine oil level.

Checking Compressed Pressure



1. Prior to inspection, check that the engine oil, starter motor and battery are normal.

2. Start the engine and run it until the engine coolant temperature reaches 80 ~ 95°C.

3. Stop the engine and disconnect the ignition coil and air cleaner element.

4. Remove the spark plug.

5. After opening the throttle valve completely, crank the engine to remove foreign material from the cylinder.

⚠ CAUTION

At this time, necessarily screen the spark plug hole with a rag. Because hot coolant, oil, fuel, and other foreign material, being penetrated in the cylinder through cracks can come into the spark hole during checking compressed pressure.
When cranking the engine to test compressed pressure, necessarily open the throttle valve before cranking.

6. Install the compression gauge to the spark plug hole.

7. With the throttle valve opened, crank the engine to measure the compressed pressure.

Standard(250~400rpm)	Standard	15kg/㎠
	Limit	14kg/㎠

8. Follow the procedures (no.6-7) to each cylinder and check that compressed pressure values of all cylinders are within the limit.

Limit	1.0kg/㎠

9. If any of all cylinders is out of limit, add a small amount of engine oil to the spark plug hole, and re-proceed the procedures (no.6-7) to the cylinder.

At this time, if the compressed pressure is increased, it means that the piston, piston ring or cylinder surface are worn or damaged, and if the compressed pressure is decreased, it means that the valve is clogged, the valve contact is faulty, or the pressure leaks through gasket.

⚠ CAUTION

If a large amount of incomplete combustion gaso-line comes into the catalytic converter, emergency such as a fire can occur due to overheating. So this job should be done quickly with the engine not operated.

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