CAT® Lift Trucks

Service Manual

K15, K21, K25 Gasoline Engine

K15
K21
K25

For use with GP15N-GP35N, GPE15N-GPE35N Chassis Service Manual.

99789-87100

Tightening Torque

Upper: Lubricated (Antirust oil is applied to abrasive faces of threads and seating faces)

Lower: No lubrication (Threads and seating faces are completely degreased)

	Thread size		Unit	4T (Bolt)	7T (Bolt)	9T (Bolt)
	Diameter	Pitch				
Hexagon head bolt and nut	M6	1	N·m	3.82 - 4.41	6.37 - 7.45	9.22 - 10.8
			(kgf-m)	(0.39 - 0.45)	(0.65 - 0.76)	(0.94 - 1.1)
			N·m	5.00 - 6.47	8.43 - 10.8	11.8 - 15.7
			(kgf-m)	(0.51 - 0.66)	(0.86 - 1.1)	(1.2 - 1.6)
	M8	1.25	N·m	9.32 - 10.8	15.7 - 17.7	22.6 - 25.5
			(kgf-m)	(0.95 - 1.1)	(1.6 - 1.8)	(2.3 - 2.6)
			N·m	12.7 - 15.7	20.6 - 26.5	29.4 - 37.3
			(kgf-m)	(1.3 - 1.6)	(2.1 - 2.7)	(3.0 - 3.8)
	M10	1.25	N·m	19.6 - 22.6	32.4 - 38.2	47.1 - 53.9
			(kgf-m)	(2.0 - 2.3)	(3.3 - 3.9)	(4.8 - 5.5)
			N·m	25.5 - 33.3	43.1 - 54.9	61.8 - 78.5
			(kgf-m)	(2.6 - 3.4)	(4.4 - 5.6)	(6.3 - 8.0)
		1.5	N·m	18.6 - 21.6	30.4 - 36.3	44.1 - 52
			(kgf-m)	(1.9 - 2.2)	(3.1 - 3.7)	(4.5 - 5.3)
			N·m	24.5 - 31.4	41.2 - 52	58.8 - 74.5
			(kgf-m)	(2.5 - 3.2)	(4.2 - 5.3)	(6.0 - 7.6)
Flanged bolt	M6	1	N·m	4.9 - 5.69	8.14 - 9.51	11.8 - 13.7
			(kgf-m)	(0.5 - 0.58)	(0.83 - 0.97)	(1.2 - 1.4)
			N·m	5.98 - 7.65	9.81 - 12.7	14.7 - 18.6
			(kgf-m)	(0.61 - 0.78)	(1.0 - 1.3)	(1.5 - 1.9)
	M8	1.25	N·m	11.8 - 13.7	19.6 - 23.5	28.4 - 33.3
			(kgf-m)	(1.2 - 1.4)	(2.0 - 2.4)	(2.9 - 3.4)
			N·m	14.7 - 18.6	24.5 - 31.4	35.3 - 45.1
			(kgf-m)	(1.5 - 1.9)	(2.5 - 3.2)	(3.6 - 4.6)
	M10	1.25	N·m	24.5 - 29.4	41.2 - 48.1	59.8 - 69.6
			(kgf-m)	(2.5 - 3.0)	(4.2 - 4.9)	(6.1 - 7.1)
			N·m	30.4 - 39.2	51.0 - 64.7	73.6 - 93.2
			(kgf-m)	(3.1 - 4.0)	(5.2 - 6.6)	(7.5 - 9.5)
		1.5	N·m	23.5 - 27.5	39.2 - 46.1	56.9 - 65.7
			(kgf-m)	(2.4 - 2.8)	(4.0 - 4.7)	(5.8 - 6.7)
			N·m	29.4 - 37.3	49.0 - 61.8	69.6 - 89.2
			(kgf-m)	(3.0 - 3.8)	(5.0 - 6.3)	(7.1 - 9.1)

CAUTION:
Except special nuts and bolts.

The bolts applicable to this table have one of the following marks embossed on their heads.

4T.....4
7T.....7
9T.....9

Diagnosis Chart by Symptom

RELATIONSHIP BETWEEN MALFUNCTIONING SYMPTOMS AND THE SENSOR CIRCUIT

The table below shows the possible symptoms caused by the malfunction of each sensor circuit.

Symptoms			Impossible to start		Poor starting		Poor idle					Poor driving control								Engine stall				Other		Check that symptoms are detected with self-diagnosis.	Check that symptoms are in fail-safe condition.	Description/notable characteristics of the symptom
Sensor malfunction ⊕: Highly possible ♦: Possible			No initial combustion	Initial combustion	When engine is cold	When engine is warming up	Fast idle is not effective	High idle rpm	Low idle rpm	Inconsistent idle when engine is cold.	Inconsistent idle when warming up	Poor power output	Poor acceleration	Engine rpm does not increase smoothly.	During surge and acceleration	During surge and constant speed driving	Knocking	Backfire	After-burn	At Idle	Driving	During deceleration	During a heavy load	Engine over temperature (Overheat)	Poor fuel consumption efficiency			
Crankshaft position sensor (POS, PHASE)		OPEN	⊕																	⊕	⊕	⊕	⊕			♦		• An open circuit in either PHASE or POS signal makes it impossible for the vehicle to start. • Control signals for fuel system and ignition system are not output.
		Momentarily open			♦	♦				♦	♦		♦	♦	♦	♦				⊕	♦	♦	♦			♦		• The symptom depends on the duration of momentarily open circuit and the operating conditions. Slight shocks and surges may be sensed during driving, while engine stall may be caused during idle.
Mass air flow sensor	Signal	OPEN			♦	♦		⊕		♦	♦	♦	♦	♦	♦	♦							♦		♦			• It will be in fail-safe condition, and vehicle runs at an engine speed from 800 rpm to 1,600 rpm.
		High output			♦	♦				♦	♦	♦	♦	♦	♦	♦				♦	♦	♦	♦		♦	♦		• The air-fuel ratio becomes rich. Black smoke may accompany. Poor connection of grounding may be a possible cause.
		Low output			♦	♦				♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦	♦		♦	♦		• The air-fuel ratio becomes lean. Contaminated hot wire or suction of air may be suspected.
	Ground	OPEN	⊕																	⊕	⊕	⊕	⊕		♦			• It will be over-rich.
	Power supply	OPEN			♦	♦		⊕		♦	♦	♦	♦	♦	♦	♦							♦		♦			• It will be in fail-safe condition, and vehicle runs at an engine speed from 800 rpm to 1,600 rpm.
Intake air temperature sensor		OPEN/ SHORT																							♦			
Engine coolant temperature sensor		OPEN/ SHORT		♦	♦	♦		♦		♦	♦	♦	♦	♦	♦	♦	♦								♦	♦		• It will be in fail-safe condition and then Engine Warning lamp turns ON. This malfunction tends to occur when engine coolant temperature is high.
		Resistance is large.		♦	♦	♦		♦			♦	♦	♦	♦	♦	♦				♦	♦	♦	♦	♦	♦	♦		• The engine coolant temperature is judged as low. This malfunction tends to occur after warming up.
		Resistance is small.		♦	♦	♦	♦		♦	♦		♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦		• The engine coolant temperature is judged as high. This malfunction tends to occur when engine is cold.
Heated oxygen sensor		OPEN/ SHORT								♦	♦	♦				♦				♦		♦	♦		♦	♦		• It will be base air-fuel ratio.

LPG Device (Specifications for LPG and Combined Use)

Inject the proper amount of fuel supplied from vaporizer based on ECM command.

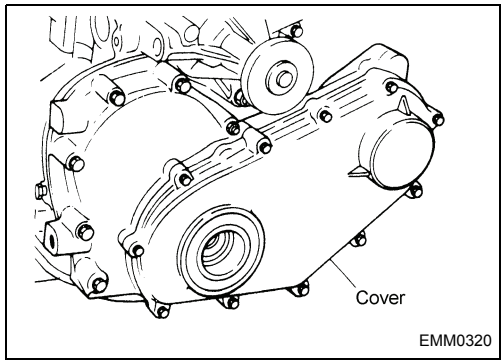
COMPONENT PARTS LOCATION

It includes mechanical relief valve with LPG injector, LPG assistance solenoid valve, and fuel pressure sensor.
It is composed of injector holder and drive unit. The drive unit operates vaporizer and injector that depress and perform carburetion of high-pressure fuel flow from LPG tank to approximately 29 kPa (0.29 bar, 0.3 kg/cm^2, 4 psi).

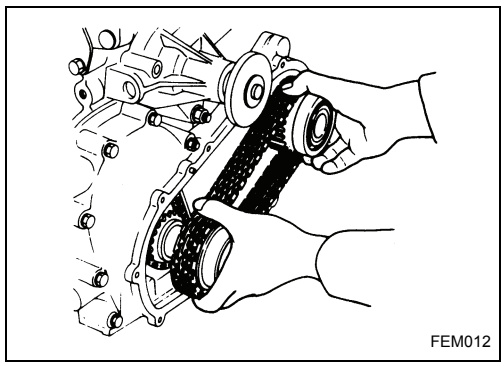
(1) LPG injector
It is used for LPG gas injection.
(2) LPG assistance solenoid valve
Engine output may be insufficient in high-speed and high load area when using LPG injector only. LPG assistance solenoid valve helps LPG injector to keep maximum engine output in high-speed and high load area.
(3) Fuel pressure sensor
Sends a signal to control fuel injection at low fuel pressure (e.g. in low temperature).
(4) Mechanical relief valve
Operates when fuel pressure is over set pressure. It opens fuel circuit, and sends fuel to intake manifold, and protects fuel piping at lower fuel pressure. It is provided in injector holder fuel passage.

- Repair each component specified in (1), (2), (3), and (4) as an assembly if a malfunction is detected in the above components. Refer to EC section for inspection procedure.

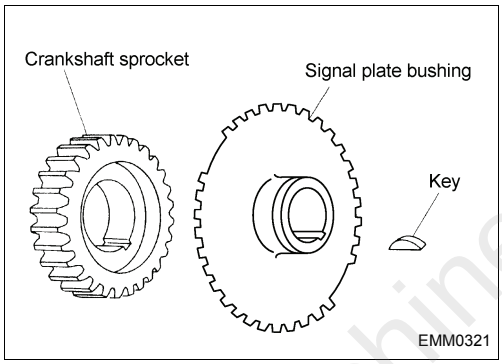
Engine Disassembly (Cont'd)



- Remove the front cover.
- To remove the cover, remove the bolts and lightly tap on it with a plastic hammer.
  Before installing the cover, apply sealant (liquid packing) to the mounting face.

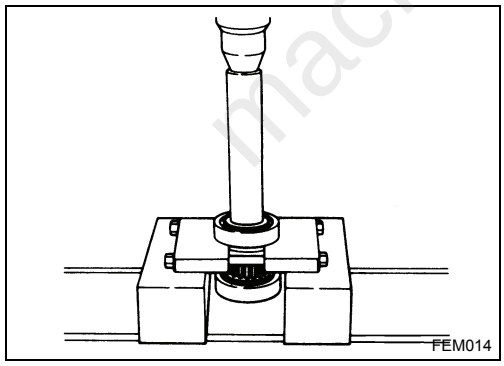


11. Remove the sprocket and chain as an assembly from the oil pump side and the crankshaft side.



After removing the retaining bolts, remove the signal plate bushing and remove the hydraulic pump sprocket along with the bearing by hand.

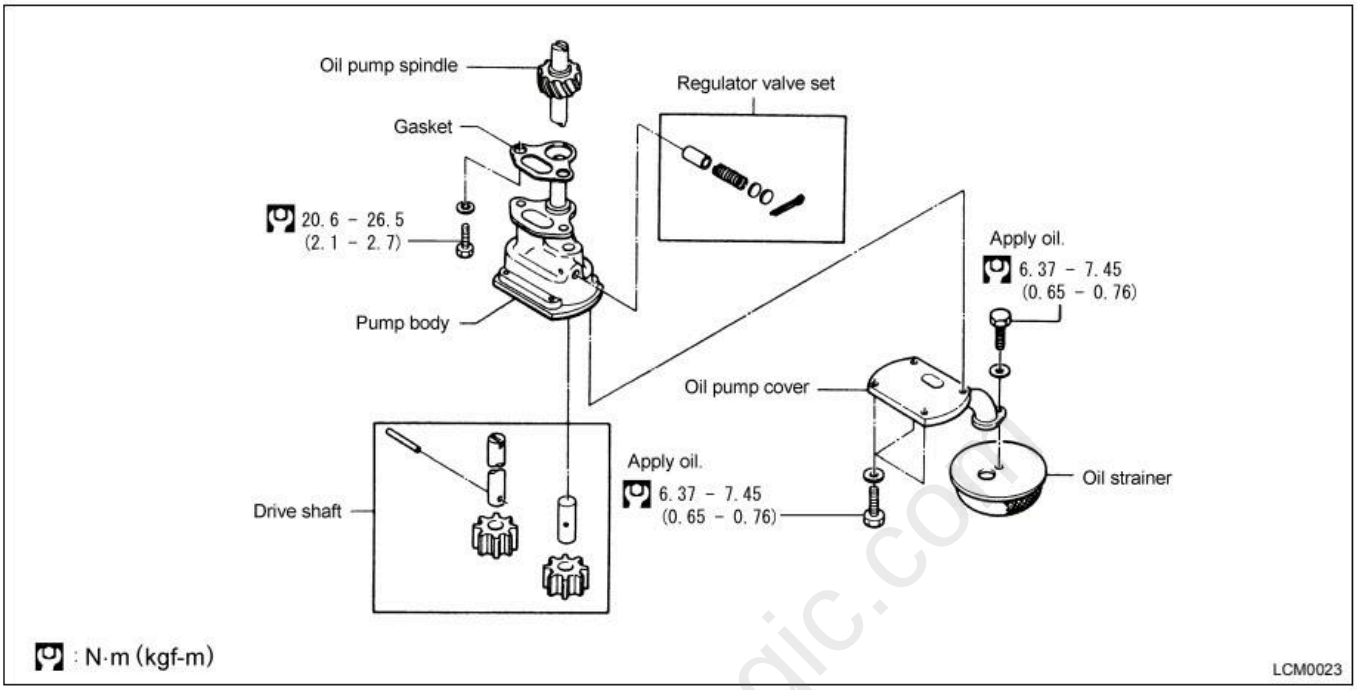
CAUTION:
Ensure that the chain is not damaged.



12. To separate the oil pressure pumpside sprocket and the bearing, use the relevant Special Service Tool with a press.
    91H20-09220 Bearing puller
    91H20-09230 Bearing drift

Oil Pump

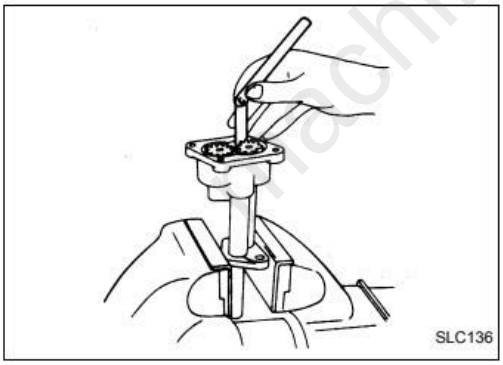
COMPONENT PARTS LOCATION



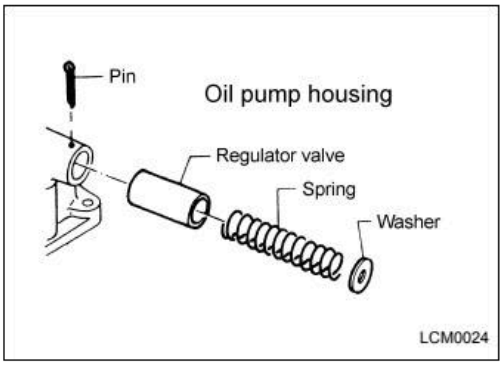
INSPECTION

1. Check the following items for wear or damages.
   - Pump body and cover
   - Pump gear section
   - Driving spindle

   The pump gear section and main body have no internal components that can be serviced separately. If the pump gear or main body is worn or damaged, replace the drive shaft assembly or oil pump assembly.

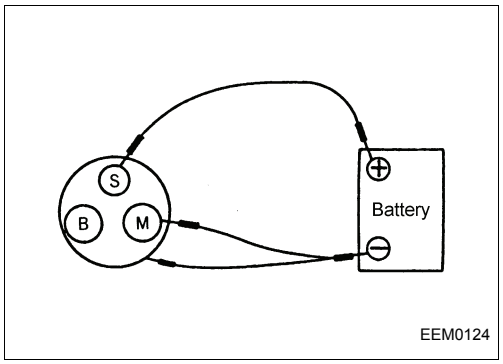


2. Inspect the clearance at the following points using a feeler gauge.
   If the clearance exceeds the specified limit, replace the drive shaft assembly or oil pump assembly.
   Clearance between pump gear and main body:
   0.4 mm or less
   Backlash of pump gear: 0.5 mm or less
   Pump gear clearance in vertical direction: 0.3 mm or less



3. Inspect the regulator valve spring of the oil pump.
   If damaged, replace the spring or pump assembly.
   Free length 41.5±1 mm
   Repair limit 40.0 mm

Overhaul

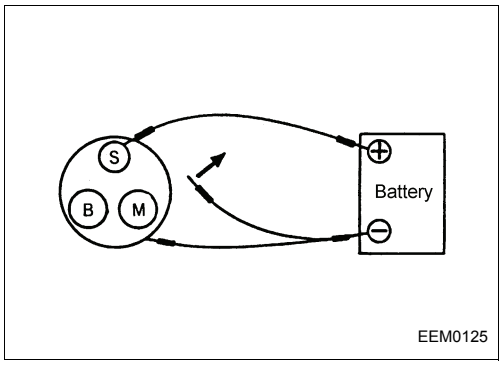


EEM0124

RELATED TO MAGNET SWITCH

- Plunger sliding face (rust, contamination, deformation)
- Broken or worn return spring
- Rough surface of main contact (burnout)
- Operation check of magnet switch
  (Proper performance of magnet coil)

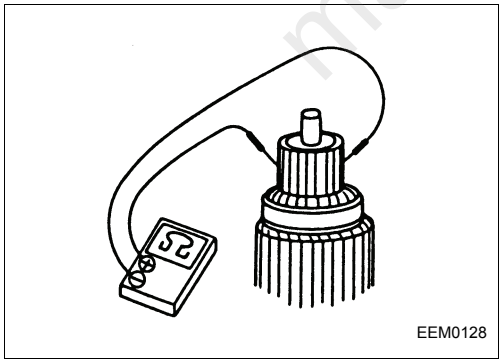
1. Plunger's drawing operation (Pull-in coil operation)
   Wire the plunger as shown in the figure on the left. The plunger should be drawn strongly by the pull-in coil and holding coil.
2. Plunger's holding operation (Holding coil operation)
   In the above circuit, disconnect the wiring from the terminal M. If the holding coil is normal, the plunger should be held in place.



EEM0125

PINION MECHANISM

- Damage or wear of pinion gear tooth tops
  Visually check for damage or wear. Replace the gear if the damage/wear is excessive.
- Pinion gear sliding face (rust, contamination, damage on spline)
  Check the pinion gear sliding motion. Replace the gear(s), if the gear(s) drag excessively.
- Overrunning clutch operation (slippage, seizure)
  Turn the pinion gear by hand. If it turns freely in both directions or will not turn in either direction, the overrunning clutch has lost its proper functionality. Replace it.


EEM0128

ARMATURE COIL

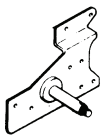
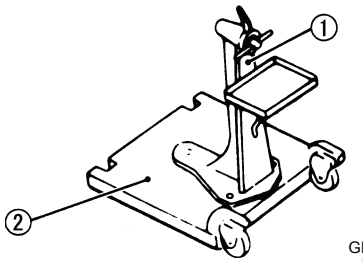
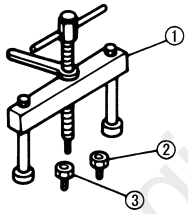
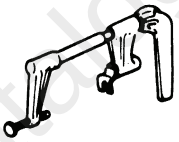
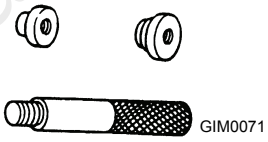
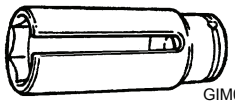
- Check the continuity between the commutators.

Judgement:

If there is continuity, the armature coil is normal.
If there is no continuity, the coil has an open circuit. Replace it.

Engine type		K21			
Engine control system		Electric controlled specifications		Carburetor specifications	
Fuel specification		Gasoline	Combined	Gasoline	Combined
Total displacement (cc)		2,065			
Shape of combustion chamber		Bathtub			
Valve mechanism		OHV			
Bore x stroke mm (in)		89 x 83 (3.50 x 3.27)			
Compression ratio		8.7			
Compression pressure [kPa (bar, kg/cm^2, psi)/rpm]		1,450 (14.5, 14.79, 210.3)/250			
Engine speed control system		Engine Control System, electric controlled throttle		Pneumatic governor	
Fuel in use (Note)		Unleaded regular gasoline	At 20P	Unleaded regular gasoline	At 20P
Valve opening/closing timing (degree)	Intake open (ATDC)	4		14	
	Intake close (ABDC)	40		30	
	Exhaust open (BBDC)	36		32	
	Exhaust close (ATDC)	0		12	
Valve clearance mm (in)	Intake (when engine is hot)	0.38 (0.0150)			
	Exhaust (when engine is hot)	0.38 (0.0150)			
Firing order		1-3-4-2			
Ignition timing (idling)	degree (BTDC°/rpm)	0±2/700		2±2/700	
On board idle speed (rpm)	ATM	700±50			
	MTM	700±50			
PTO system		Silent chain-driven/side PTO			
Engine oil (originally fitted)	Specification	10W-30 (Class SL)			
	Amount l (US qt, Imp qt)	3.8 (4, 3-3/8) (including oil filter)			

Note: Fuel
Gasoline: Use unleaded regular gasoline with an octane rating of 91 or more.
LPG: Use a fuel of 30P or more in cold seasons. In ambient temperature of -5°C (23°F) or less, use a 100P fuel.

Tool number	Tool name	
91H20-09080	Engine attachment  GIM0066	
91H-20-09090 (1) 91H20-09091 (2) 91H20-09092	Engine stand assembly Engine stand Stand  GIM0067	
91H20-09100 (1) 91H20-09110 (2) 91H20-09111 (3) 91H20-09112	Crankshaft main bearing cap puller Crankshaft main bearing puller Adapter Adapter  GIM0068	
91H20-09120	Valve lifter  GIM0069	
91H20-09150 91H20-09160 91H20-09170	Front oil seal drift Rear oil seal drift Drift rod  GIM0071	
91H20-09020	Heated oxygen sensor wrench  GIM0072	Removing and installing heated oxygen sensor

Full Version Available

Caterpillar GP18NT Forklift Engine Service Manual (99789-87100)

Caterpillar GP18NT forklift engine service manual, covers testing, adjustment, teardown, and engine systems. Downloadable PDF format.