McCORMICK

CT Series
Service Manual



McCormick CT28 and CT36 Series Tractors

JULY 2007

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GENERAL INFORMATION

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2. Serial number location 2

COMPONENT LOCATION
S3L/S3L2 3
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PRIME POWER OUTPUT CHART 6

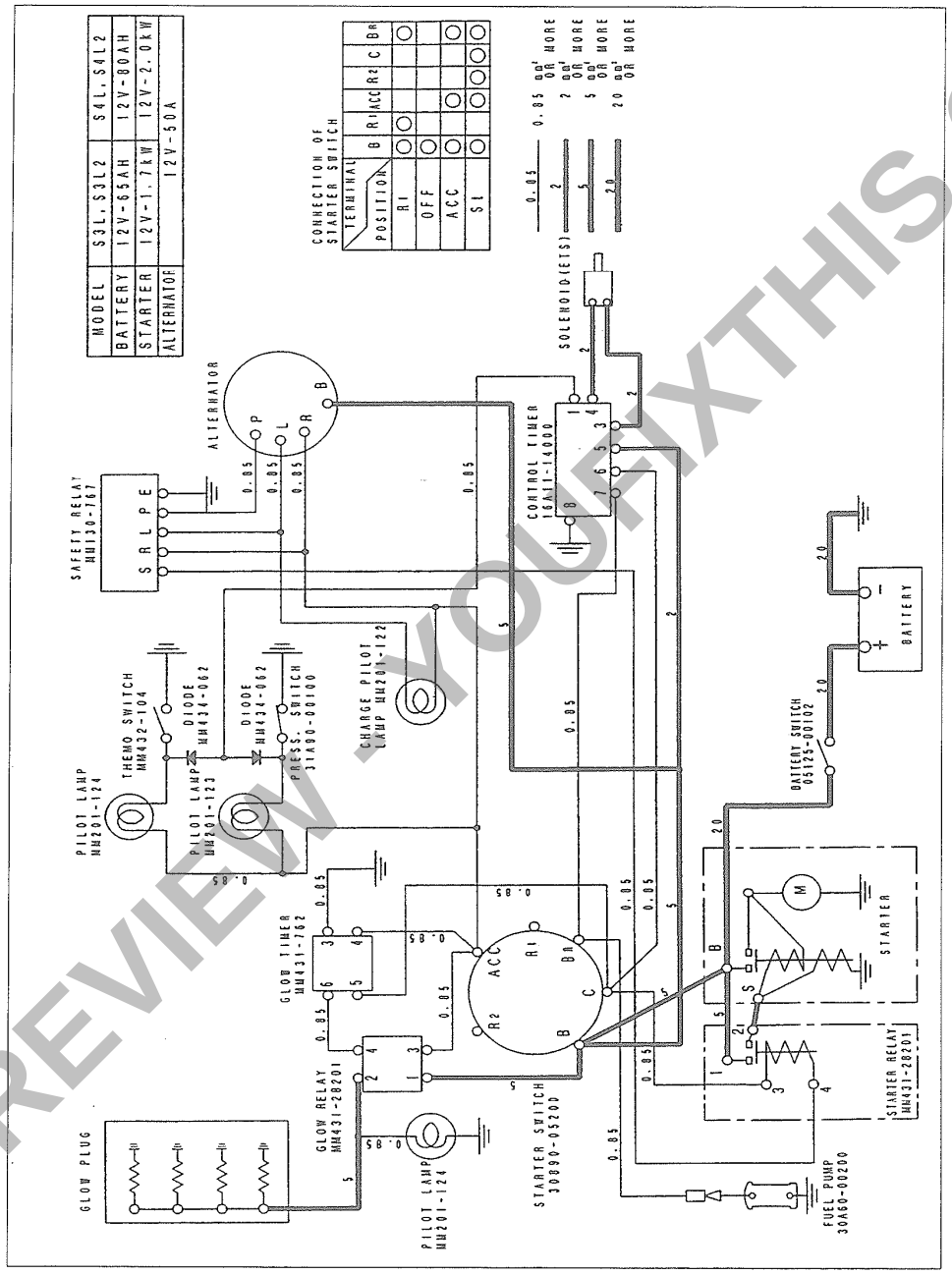
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GENERAL

1. Schematic

< Solenoid ETS type >

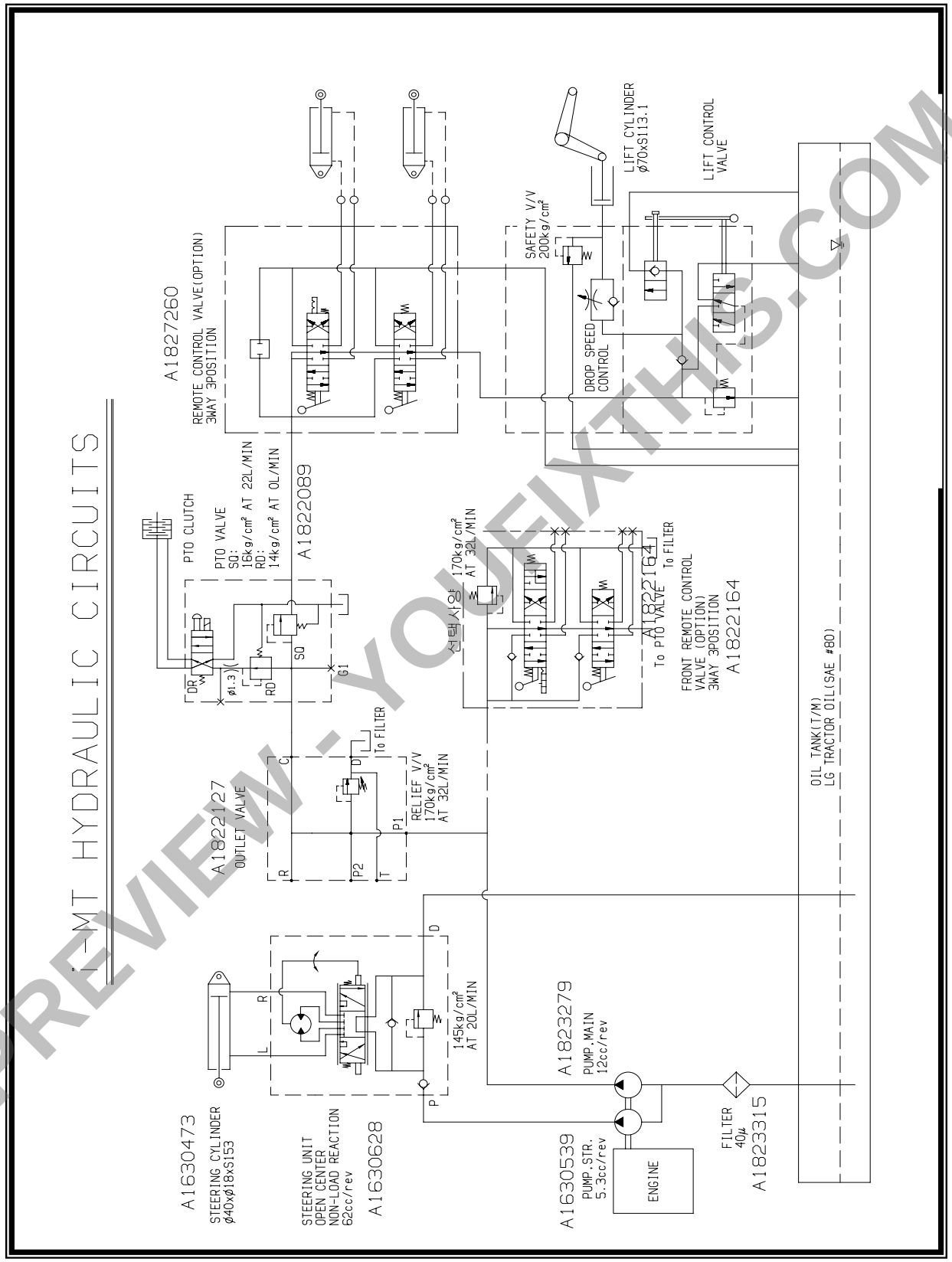


(1) Figure indicates a nominal size of automotive low-tension line (JIS C 3406).

(2) This schematic shows the electrical system of the standard engine equipped with a key shut down solenoid and glow plugs.

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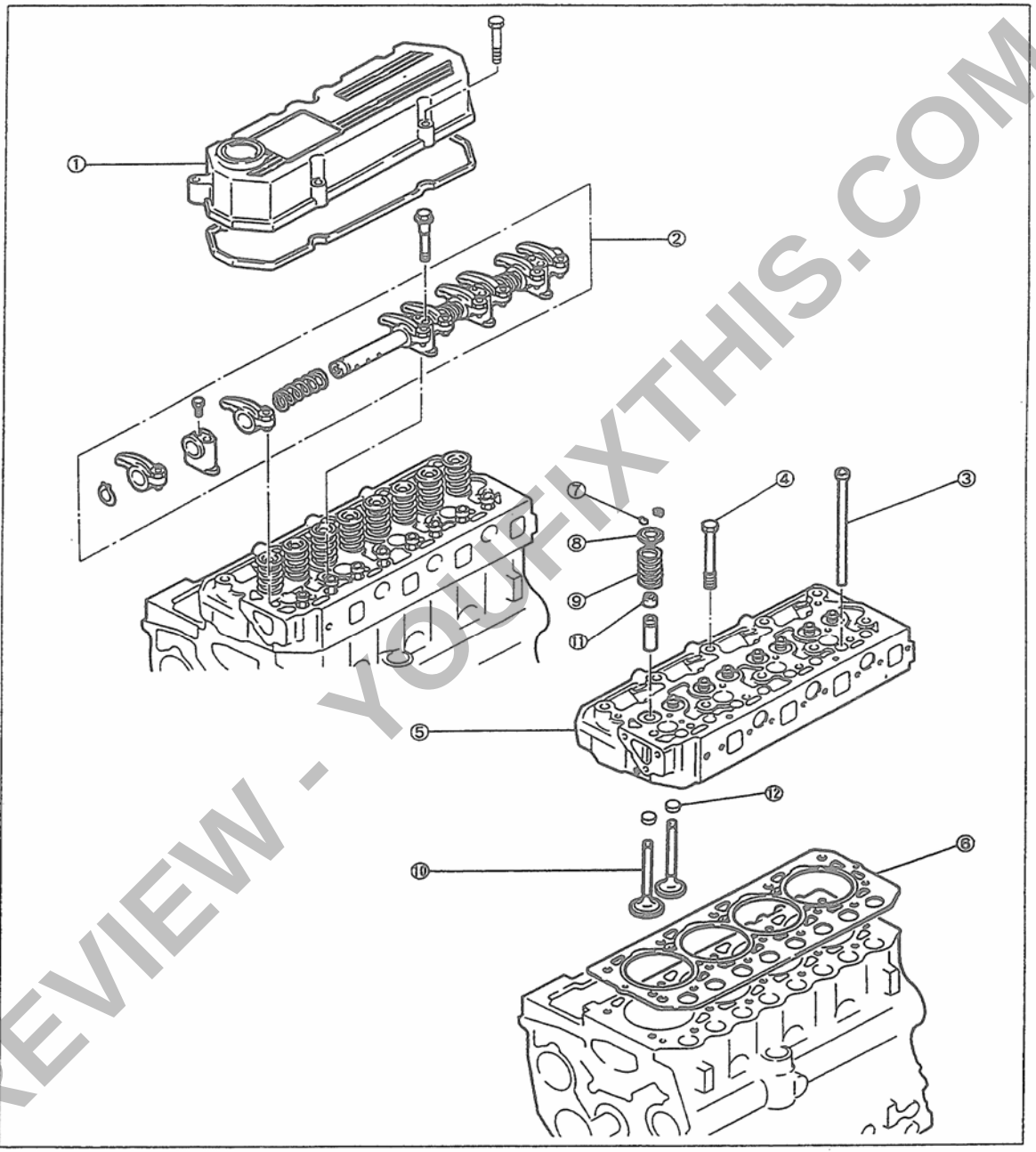
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CYLINDER HEAD AND VALVE MECHANISM



① Rocker cover
② Rocker shaft assembly
③ Valve push rod
④ Cylinder head bolt
⑤ Cylinder head
⑥ Cylinder head gasket
⑦ Valve lock
⑧ Valve retainer
⑨ Valve spring
⑩ Valve
⑪ Valve stem seal
⑫ Valve cap

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TIGHTENING TORQUES

1. Major bolts and nuts

Bolt or nut	Thread, mm				Torque, kgf·m (lbf·ft) [N·m]
	Diameter	Pitch	Width across flats	Clamp length	
Cylinder head bolt	M10	1.25	14	87	9 ± 0.5 (65 ± 4) [88 ± 5]
Rocker cover bolt	M8	1.25	12	40	1.15 ± 0.15 (8.3 ± 1.1) [11.3 ± 1.5]
Rocker shaft bracket bolt	M8	1.25	12	58	1.5 ± 0.5 (11 ± 4) [14.7 ± 5]
Thermoswitch	M16	1.5	17	31.5	2.3 ± 0.4 (16.6 ± 3) [22.6 ± 4]
Crankshaft pulley nut	M18	1.5	27	—	17.5 ± 2.5 (127 ± 18) [172 ± 25]
Main bearing cap bolt	M10	1.25	17	81	5.25 ± 0.25 (38 ± 2) [51.5 ± 2.5]
Connecting rod cap nut	M9	1.0	14	—	3.55 ± 0.25 (25.7 ± 2) [34.8 ± 2.5]
Rear plate bolt (for tractor engine)	M12	1.25	17	28	9.5 ± 1 (69 ± 7) [93 ± 10]
Rear plate bolt (standard)	M12	1.25	17	28	6.5 ± 1 (47 ± 7) [64 ± 10]
Rear plate bolt (stamping)	M8	1.25	12	16	1.15 ± 0.15 (8.3 ± 1.1) [11.3 ± 1.5]
Flywheel bolt	M12	1.25	19	29	13.5 ± 0.5 (98 ± 4) [132 ± 5]
Oil pan bolt (for tractor engine)	M8	1.25	12	25	2.8 ± 0.3 (20.3 ± 2.2) [27.5 ± 3]
Oil pan drain plug	M14	1.5	22	10	4 ± 0.5 (29 ± 4) [39 ± 5]
Pressure relief valve	M22	1.5	22	33	5 ± 0.5 (36 ± 4) [49 ± 5]
Oil filter	M20	1.5	—	—	1.2 ± 0.1 (8.7 ± 0.7) [12 ± 1]
Oil pressure switch	PT1/8	—	26	11	1 ± 0.2 (7.2 ± 1.4) [10 ± 2]
Fuel injection pipe nut	M12	1.5	—	—	3 ± 0.5 (22 ± 4) [29 ± 5]
Fuel leak-off pipe nut	M12	1.5	18	—	2.75 ± 0.25 (20 ± 2) [27 ± 2.5]
Delivery valve holder	—	—	19	—	4.5 ± 0.5 (32.5 ± 4) [44 ± 5]
Fuel injection nozzle holder	M20	1.5	21	—	5.5 ± 0.5 (40 ± 4) [54 ± 5]
Retaining nut for delivery valve holder body	M16	0.75	19	—	3.75 ± 0.25 (27 ± 2) [37 ± 2.5]
Sliding sleeve shaft	M10	1.25	14	29.5	3.6 ± 0.6 (26 ± 4) [35 ± 6]
Special nut for torque spring set	M12	1.0	17	—	2 ± 0.5 (14 ± 4) [20 ± 5]
Glow plug	M10	1.25	12	60	1.75 ± 0.25 (12.7 ± 2) [17.2 ± 2.5]
Glow plug connection plate	M4	0.7	8	—	0.125 ± 0.025 (0.9 ± 0.2) [1.2 ± 0.2]
Stop solenoid nut	M30	1.5	36	—	4.5 ± 0.5 (32.5 ± 4) [44 ± 5]
Starter B terminal	M8	1.25	12	—	1.1 ± 0.1 (8 ± 0.7) [10.8 ± 1]

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2. Engine troubleshooting

Problem 1: Hard starting

(1) Items to be checked for ahead

- Clogged air cleaner
- Wrong oil grade for weather conditions
- Poor quality fuel
- Low cranking speed

(2) Inspection procedure

Is heating system normal? — No ⇨ Glow plugs are energized shortly after starter switch is turned to ON. — No ⇨ Check control timer unit.

⇩ Yes

Are fuel lines free of restriction? (Is fuel pump operating properly when starter switch in ON position?) — No ⇨ Check fuel filter, fuel lines and fuel tank.

⇩ Yes

Are fuel injection timing and valve clearance correct? — No ⇨ Make adjustment to the timing and clearance.

⇩ Yes

Is fuel injection nozzle discharge pattern normal? Is injection pressure correct? — No ⇨ Make adjustment to the nozzles.

⇩ Yes

Is compression pressure correct? — No ⇨ Check valves, piston rings and cylinder head gasket.

⇩ Yes

Fuel injection pump is faulty.

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SPECIFICATIONS

Model		S3L	S3L2	S4L	S4L2
Type		Water-cooled, 4-stroke cycle, in-line diesel engine			
Firing order (injection sequence)		1 - 3 - 2		1 - 3 - 4 - 2	
Compression ratio		22			
Combustion chamber, type		Swirl			
Weight, kg (lb)		125 (276)		150 (331)	
No. of cylinders		3		4	
Bore x Stroke, mm (in.)		78 x 78.5 (3.07 x 3.09)	78 x 92 (3.07 x 3.62)	78 x 78.5 (3.07 x 3.09)	78 x 92 (3.07 x 3.62)
Displacement, liter (cu in.)		1.125 (68.7)	1.318 (80.4)	1.500 (91.5)	1.758 (107.3)
Fuel system	Injection pump, type	Bosch M			
	Injection nozzle, type	Throttle			
	Governor, type	Centrifugal flyweight			
	Fuel	ASTM No. 2-D			
Lubrication system	Type	Force feed (by trochoid pump)			
	Engine oil	API Service Classification CD			
	Oil filter	Paper-element (full-flow)			
	Capacity (high level excl. 0.5 liter (0.13 U.S. gal) of oil in oil filter), liter (U.S. gal)	5.7 (1.5) (with deep oil pan) 3.7 (1.0) (with standard oil pan)		7.7 (2.0) (with deep oil pan) 5.4 (1.4) (with standard oil pan)	
Cooling system	Type	Forced cooling			
	Capacity (approximate), liter (U.S. gal)	1.8 (0.5)		2.5 (0.7)	
Starter, V – kW		12 – 1.7		12 – 2.0	
Alternator, V – A		12 – 50			

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ELECTRICAL SYSTEM

1. Starter

1.1. Testing before disassembly

(1) Clearance between pinion and housing (pinion clearance)

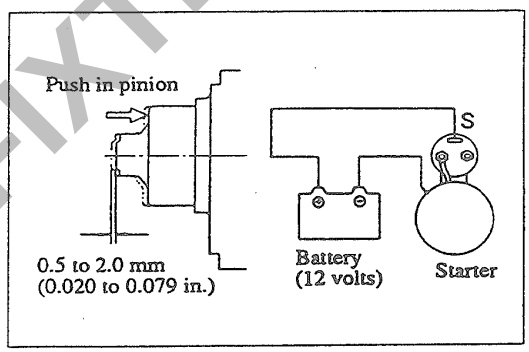
(a) Connect the starter to a 12 volt battery as shown in the illustration to cause the pinion to shift into cranking position and remain there.

⚠ CAUTION

Due to the amount of current being passed through the solenoid series winding, this test must be made within 10 seconds.

(b) Push the pinion toward the commutator end by hand to measure its free movement (pinion clearance).

(c) The pinion clearance must be 0.5 to 2.0 mm (0.020 to 0.079 in.). If the clearance is out of this range, make an adjustment to it by adding or removing the packings on the magnetic switch. Adding the packings will decrease the clearance.

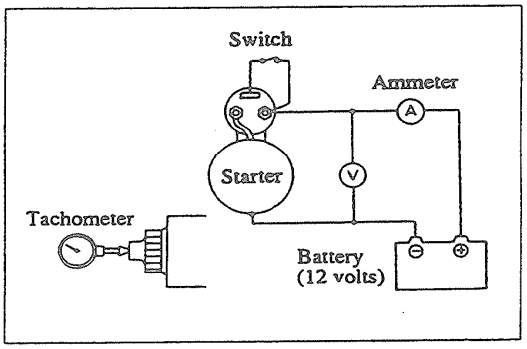


Connections for measuring pinion clearance

(2) No-load characteristics

(a) Connect the starter to a 12 volt battery with an ammeter capable of indicating several hundred amperes as shown in the illustration.

(b) Close the switch to make sure the pinion shifts into cranking position properly and the starter runs at speeds higher than is specified. If the current draw and/or operating speed is out of the standard, disassemble the starter for inspection and repairs.



Connections for testing no-load characteristics

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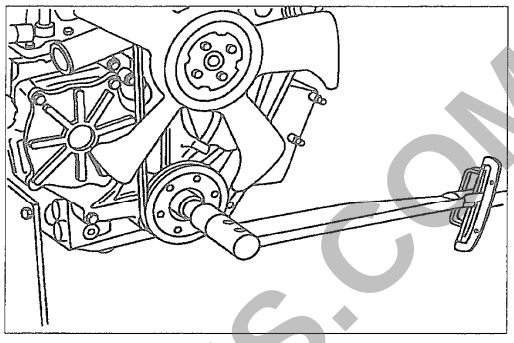
1. Flywheel removal

(1) Have someone hold the crankshaft pulley with a wrench to prevent the flywheel from rotating.

(2) Remove one of the bolts that hold the flywheel in position.

⚠ WARNING

Always signal each other to prevent possible personal injury.



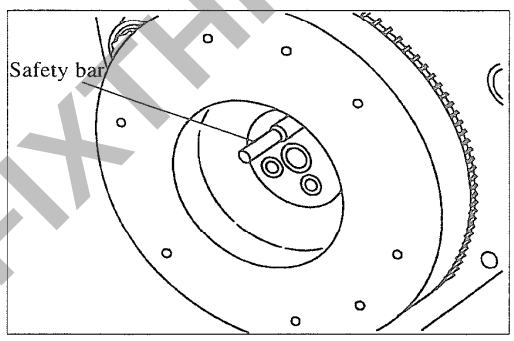
Holding flywheel

(3) Install a safety bar (M12 x 1.25) into the threaded hole in the flywheel from which the bolt was removed in Step (2). Remove the remaining bolts.

(4) Hold the flywheel by hands and withdraw it from the crankshaft. Joggling the flywheel back and forth will facilitate removal.

⚠ WARNING

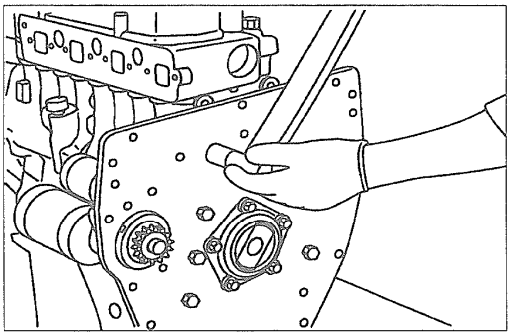
When removing the flywheel, wear heavy gloves to avoid hand injury.



Removing flywheel

2. Rear plate removal

The rear plate is doweled in position. Pull the plate as straight as possible when removing it.



Removing rear plate

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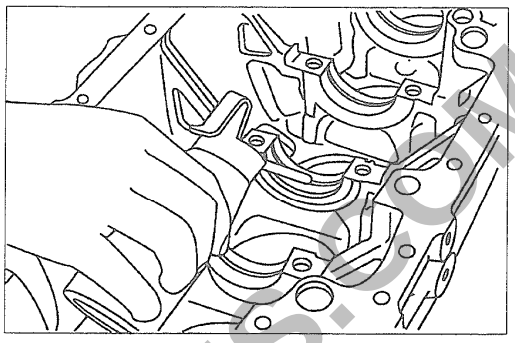
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1. Main bearing installation

(1) Install the upper halves of the main bearings in the cylinder block and the lower halves in the main bearing caps so their tabs fit into the notches in the cylinder block and the main bearing caps.

(2) Install the flanged bearing in the No. 3 journal.

(3) Lightly lubricate the inside surfaces of the bearings with engine oil.



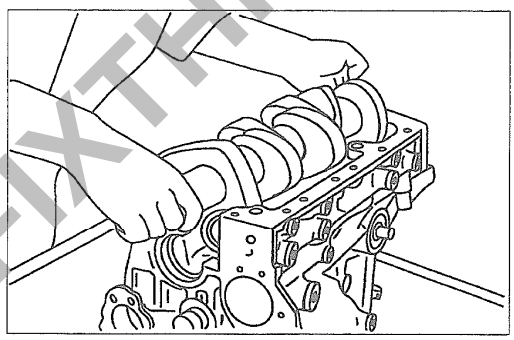
Installing main bearings

2. Crankshaft installation

(1) Clean the crankshaft with cleaning solvent and blow dry with compressed air.

(2) Fasten a hoist to the crankshaft and hold it in horizontal position. Carefully put the crankshaft in position in the cylinder block.

(3) Lightly lubricate the crankshaft journals with engine oil.



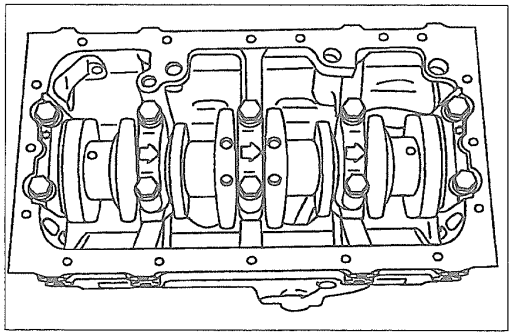
Installing crankshaft

3. Main bearing cap installation

(1) Coat the mating surfaces of the rear bearing cap and cylinder block with Three Bond 1212.

(2) Install the main bearing caps in position. Make sure the number (arrow head) on the main bearing cap is toward the front of the engine.

(3) Tighten the main bearing cap bolts finger tight only.



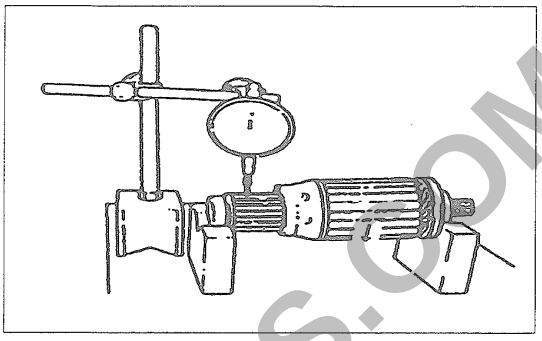
Main bearing caps installed

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(c) Commutator Inspection

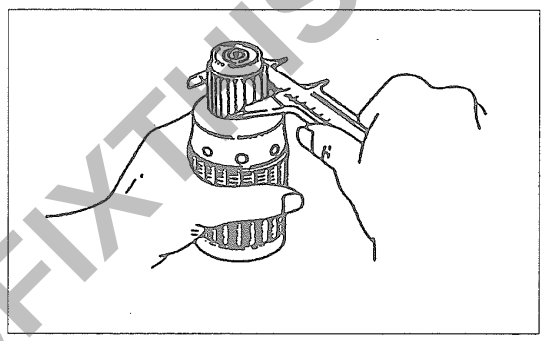
1) Measure the commutator's runout using a dial gauge. If the measurement exceeds the specified limit, rectify the problem, making sure that the outside diameter stays within specification. If the surface is rough or has stepped wear, rectify the problem with emery paper (#300 – 500).



Unit: mm (in.)

	Limit
Commutator runout	0.1 (0.004)

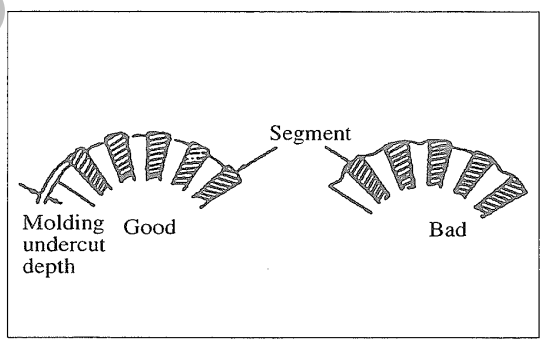
2) Measure the commutator's outside diameter. If the measurement is out of specification, replace the armature.



Unit: mm (in.)

	Standard value	Limit
Commutator outside diameter	32.0 (1.26)	31.4 (1.24)

3) Measure the molding undercut depth between segments. If the depth is smaller than the limit, cut the molding to a depth of 0.4-0.6 mm (0.016-0.024 in).



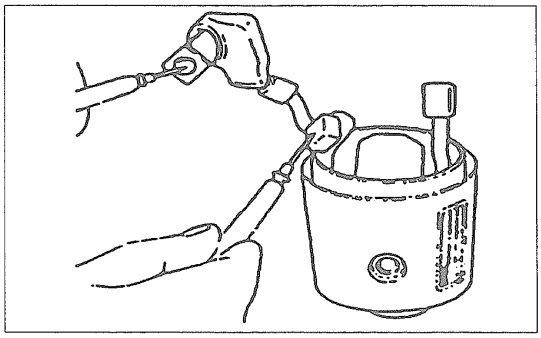
Unit: mm (in.)

	Limit
Molding undercut depth between segments	0.2 (0.008) maximum

(2) Field Coil

(a) Coil Open Circuit Test

Check whether continuity exists between the terminal lead and each brush. If continuity does not exists, the field coil has an open circuit and the yoke assembly must be replaced.



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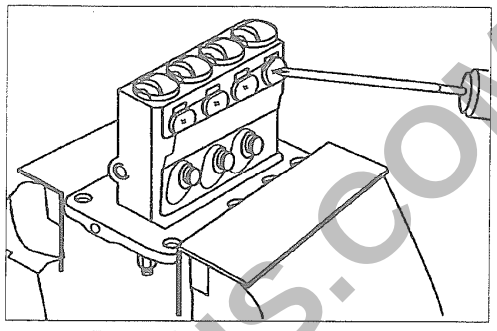
Disassembly procedure

(1) Tappet removal

(a) Hold the injection pump in a vise with the side that has tappets up.

(b) Straighten the lock plate away from the tappet guide pin with a screwdriver.

(c) Rotate the tappet guide pin 180° to unlock it from the housing.



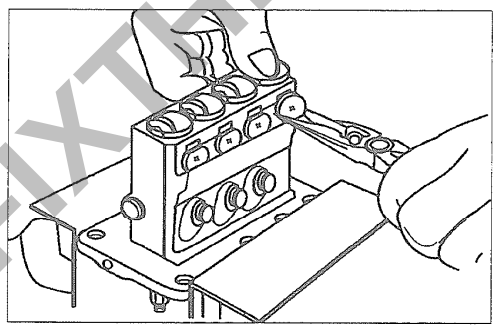
Removing tappet guide pins

(d) Remove the tappet guide pin with a needle-nose pliers while pushing down on the tappet. Remove the tappet.

(e) Do Steps (b) through (d) again for remainder of the tappets.

⚠ CAUTION

The tappet can be thrown from the housing when the tappet guide pin is removed. Hold the tappet to prevent it from falling.



Removing tappets

(2) Plunger removal

(a) Remove the tappet adjusting shim.

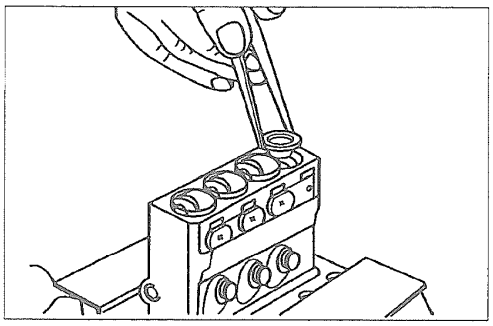
(b) Remove the lower spring seat and plunger with a tweezers.

(c) Remove the plunger spring.

(d) Remove the upper spring seat and control sleeve.

(e) Do Steps (a) through (d) again for remainder of the plungers.

(f) Remove the control rack.



Removing plungers

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6. Electrical system

Unit: mm (in.)

Item				Standard		Limit	Correction·Remarks
Starter	Pinion clearance			0.5 to 2.0 (0.020 to 0.079)		—	Adjust with packing.
	No-load characteristics			S3L/S3L2	S4L/S4L2		Test.
			Terminal voltage	11.5 V	11 V	—	
			Current draw	100 A maximum	130 A maximum	—	
			min^{-1}	3 000 minimum	3 600 minimum	—	
	Brush length			—		Wear limit line	Replace.
	Brush spring tension			3.0 kgf (6.6 lbf) [29.4 N]		1.8 kgf (4.0 lbf) [17.7 N]	Replace.
	Runout of commutator			0.03 (0.001 2)		0.10 (0.003 9)	Repair or replace.
	Diameter of commutator			32 (1.26)		31 (1.22)	Replace.
	Undercut of mica			0.5 (0.020)		0.2 (0.008)	Repair.
Alternator	Regulated voltage at 20°C (68°F)			14.7 ± 0.3 V		—	
	Output characteristics (at operating temperature)	Below 2500 min^{-1}	Terminal voltage	13.5 V		—	Test.
			Current	33 A		—	
		Below 500 min^{-1}	Terminal voltage	13.5 V		—	
			Current	47 A		—	
	Brush length			—		Wear limit line	Replace.
Resistance in glow plug				0.55 Ω		—	Replace.

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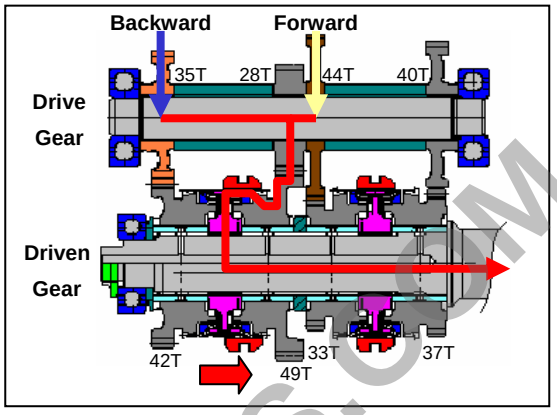
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Main Transmission per stage

- **Stage 1**

  - Main transmission is composed of gear type.

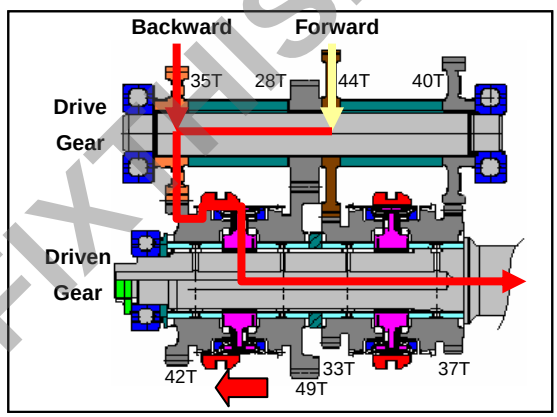
  - Drive gear(28T) and non-drive gear(49T) are connected.



- **Stage 2**

  - Main transmission is composed of gear type.

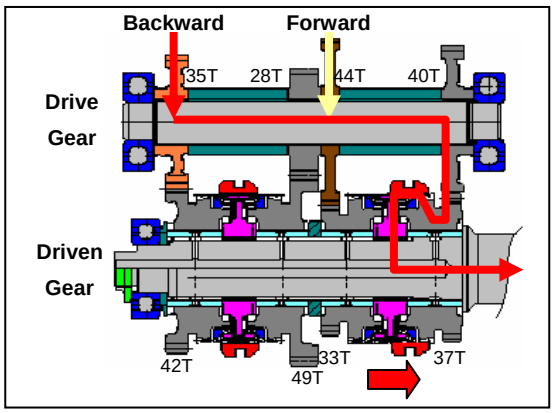
  - Drive gear(35T) and driven selective gear(42T) is connected directly to transmit the power.



- **Stage 3**

  - Main transmission is composed of gear type.

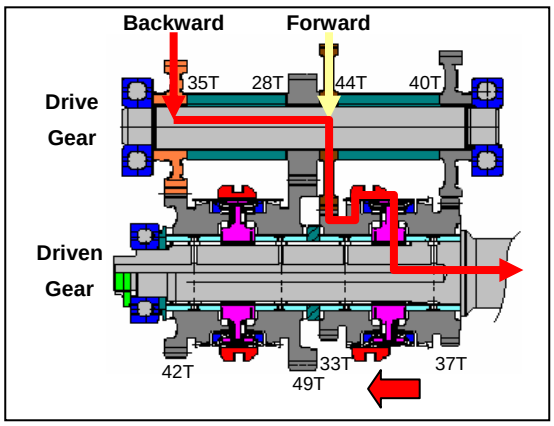
  - Drive gear(40T) and driven selective gear(37T) is connected directly to transmit the power.



- **Stage 4**

  - Main transmission is composed of gear type.

  - Drive gear(44T) and driven gear(38T) is connected.



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4. FRONT AXLE

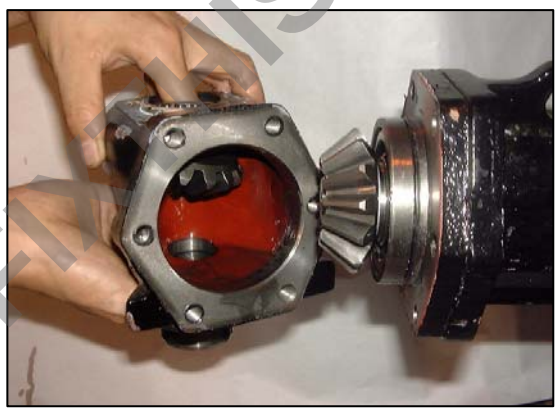
• Remove the reamer bolt. (1ea)

• When assembling, pay attention to the reamer bolt not to be changed with other bolt.

Tightening force	8.5 ~ 10.0 kg-f-m



• Remove the king pin case. At this time, remove the gear, spacer and bearing together.



• Notices in Assembling

  • As it is hard to assemble the spacer, assemble the gear case and king ping case first before assembling the spacer.

  • Refer to adjustment & assembling.

• Internal parts of King Ping Case

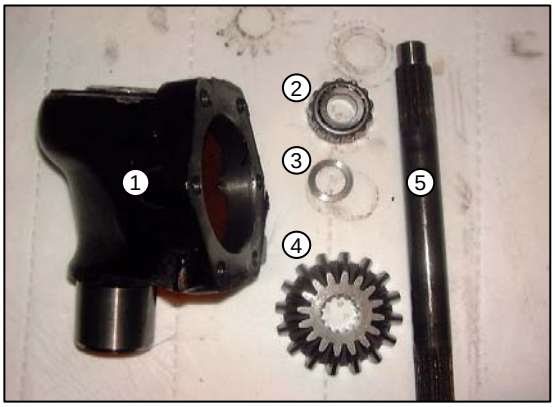
  (1) King pin case

  (2) Taper bearing

  (3) Spacer

  (4) Gear(16T)

  (5) Axle

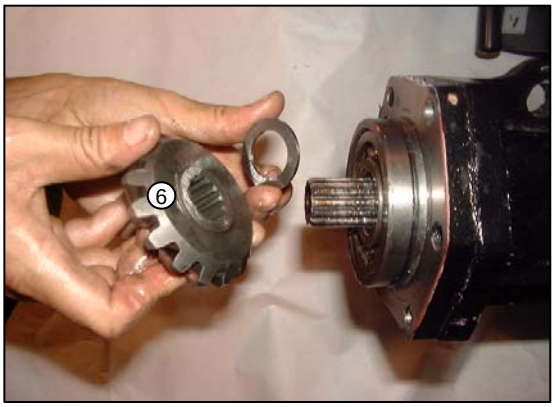


• Remove the driving gear(13T), spacer and liner.

• Adjust the liner at standard after measuring the clearance of gear(1) on the above items and gear(6) on the right figure.

  • liner (2 types) : 0.1mm & 0.5mm

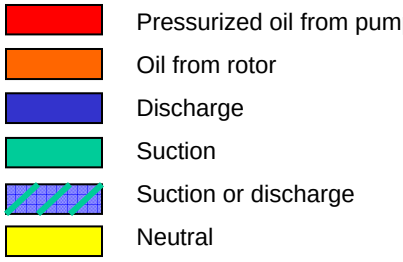
Clearance	0.2 ~ 0.4mm



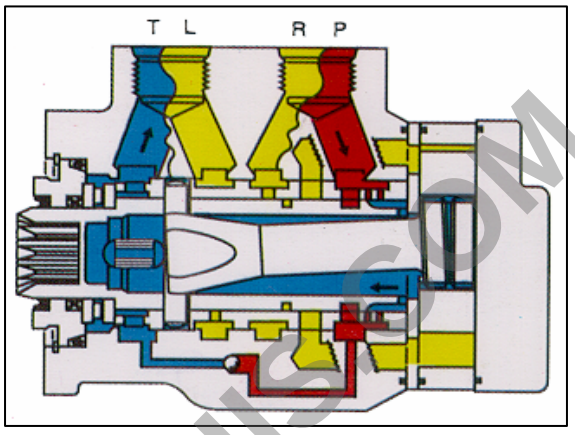
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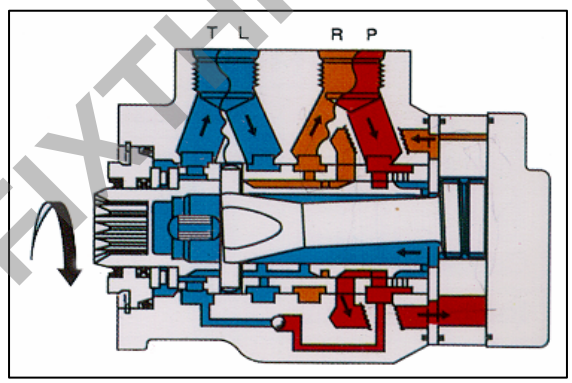
1) Neutral position



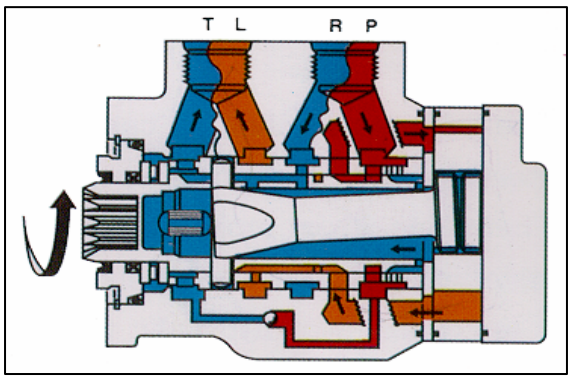
Pressurized oil from pump
Oil from rotor
Discharge
Suction
Suction or discharge
Neutral



2) Steering to the right

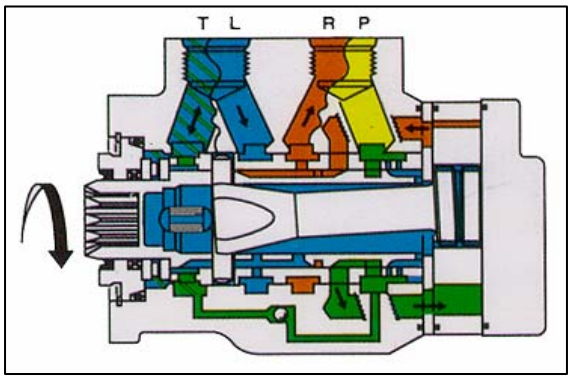


3) Steering to the left



(1) In an emergency , steering manually

If the steering wheel becomes very difficult to operate while operating with emergency manual steering, stop manual steering and transport the tractor by trailer.



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