GENERAL

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SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and on labels on the machine itself to warn of the possibility of personal injury. Read these instructions carefully.

It is essential that you read the instructions and safety regulations before you attempt to repair or use this unit.

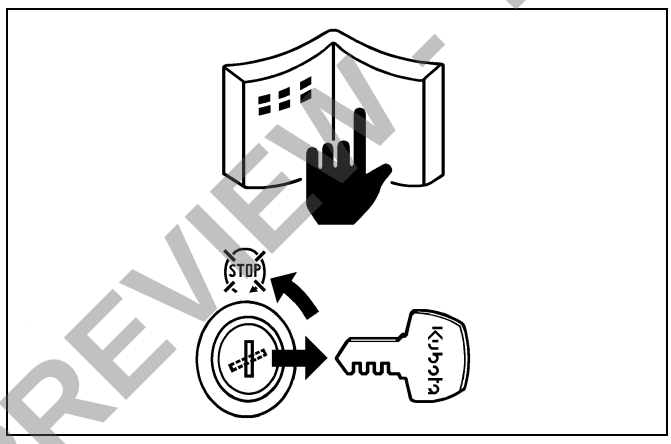
DANGER : Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING : Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION : Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

■ IMPORTANT : Indicates that equipment or property damage could result if instructions are not followed.

■ NOTE : Gives helpful information.



BEFORE SERVICING AND REPAIRING

- Read all instructions and safety instructions in this manual and on your machine safety decals.
- Clean the work area and machine.
- Park the machine on a firm and level ground, and set the parking brake.
- Lower the implement to the ground.
- Stop the engine, and remove the key.
- Disconnect the battery negative cable.
- Hang a "**DO NOT OPERATE**" tag in operator station.

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SPECIFICATIONS

Model		ZD21N-EC	ZD21-EC	ZD28-EC
Maximum gross power (SAE)		15.7 kW (21 HP)*1		20.9 kW (28 HP)*1
Engine	Model	D782-E-XFM5		D1105-E2-ZD
	Type	Indirect injection, vertical, water cooled, 4-cycle diesel engine		
	Number of cylinders	3		
	Bore and stroke	67.0 × 73.6 mm (2.64 × 2.90 in.)		78.0 × 78.4 mm (3.07 × 309 in.)
	Total displacement	778 cm^3 (47.5 cu.in.)		1123 cm^3 (68.5 cu.in.)
	Rated revolution	3200 rpm		3000 rpm
	Combustion chamber	Spherical type (E-TVCS)		
	Fuel injection pump	Bosch MD type mini pump		
	Governor	Centrifugal ball mechanical governor		
	Injection nozzle	Bosch throttle type		
	Injection timing	0.33 to 0.37 rad (19° to 21°) before T.D.C.		
	Injection order	1-2-3		
	Injection pressure	13.73 MPa (140 kgf/cm^2, 1990 psi)		
	Lubricating system	Forced lubrication by gear pump		
	Cooling system	Pressurized radiator, forced circulation with water pump		
	Lubricating oil	API Service classification CC or CD, Below 0 °C (32 °F) : SAE 10W or 10W-30, 0 to 25 °C (32 °F to 77 ° F) : SAE 20 or 10W-30, Above 25 °C (77 °F) : SAE 30 or 10W-30		
	Starting system	Electric starter (12 V, 1.1 kW)		
	Battery	51 R (12 V, 450 CCA)		
	Fuel	No. 2-D Diesel fuel (ASTM D975) [No. 1-D diesel fuel, if temperature is below – 10 °C (14 °F)]		
Capacities	Fuel tank	30 L (5.8 U.S.gals., 4.8 Imp.gals.)		
	Engine crankcase	3.5 L (3.7 U.S.qts., 3.1 Imp.qts.)		3.4 L (3.6 U.S.qts., 3.0 Imp.qts.)
	Engine coolant	2.6 L (2.7 U.S.qts., 2.3 Imp.qts.)		3.8 L (4.0 U.S.qts., 3.3 Imp.qts.)
	Recovery tank	0.25 L (0.26 U.S.qts., 0.22 Imp.qts.)		
	Transmission (Including HST and cylinder)	4.0 L (4.2 U.S.qts., 3.5 Imp.qts.)*2		
	Rear axle gear case	1.8 L (1.9 U.S.qts., 1.6 Imp.qts.)*2 each		
	Mower gear case oil	0.40 L (0.42 U.S.qts., 0.35 Imp.qts.)		
Tires	Front	15 × 6.0-6 (4PR) Rib		
	Rear	23 × 10.5-12 (4PR) Turf	24 × 12.0-12 (4PR) Turf	
Travelling speeds	Forward	0 to 14.5 km/h (0 to 9.0 mph)*3	0 to 15.0 km/h (0 to 9.3 mph)*3	0 to 15.0 km/h (0 to 9.3 mph)*4
	Reverse	0 to 8.0 km/h (0 to 5.0 mph)*3	0 to 8.3 km/h (0 to 5.2 mph)*3	0 to 8.3 km/h (0 to 5.2 mph)*4

NOTE: *1 Manufacturer's estimate
*2 Oil amount when the oil level is at the upper level.
*3 At 3200 engine rpm
*4 At 3000 engine rpm

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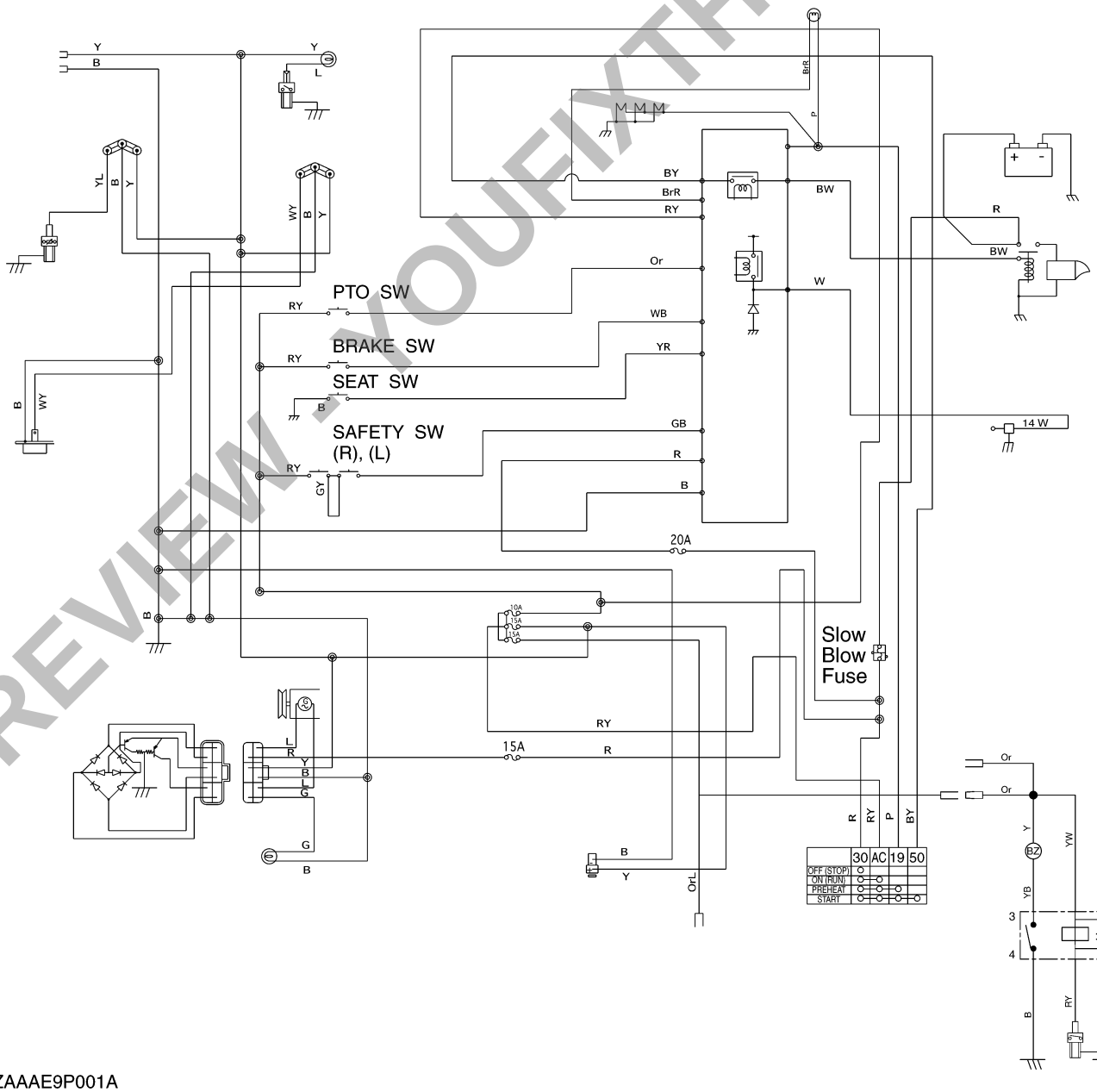
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1. WIRING DIAGRAM

[ZD21N · ZD21]

• **Color or Wiring**

W ····· White	Or ····· Orange	BrR ····· Brown / Red	BW ····· Black / White
R ····· Red	BY ····· Black / Yellow	WR ····· White / Red	BR ····· Black / Red
L ····· Blue	WB ····· White / Black	WY ····· White / Yellow	GW ····· Green / White
P ····· Pink	GB ····· Green / Black	RW ····· Red / White	YR ····· Yellow / Red
B ····· Black	OrL ····· Orange / Blue	RY ····· Red / Yellow	YL ····· Yellow / Blue
G ····· Green	YB ····· Yellow / Black	YW ····· Yellow / White	

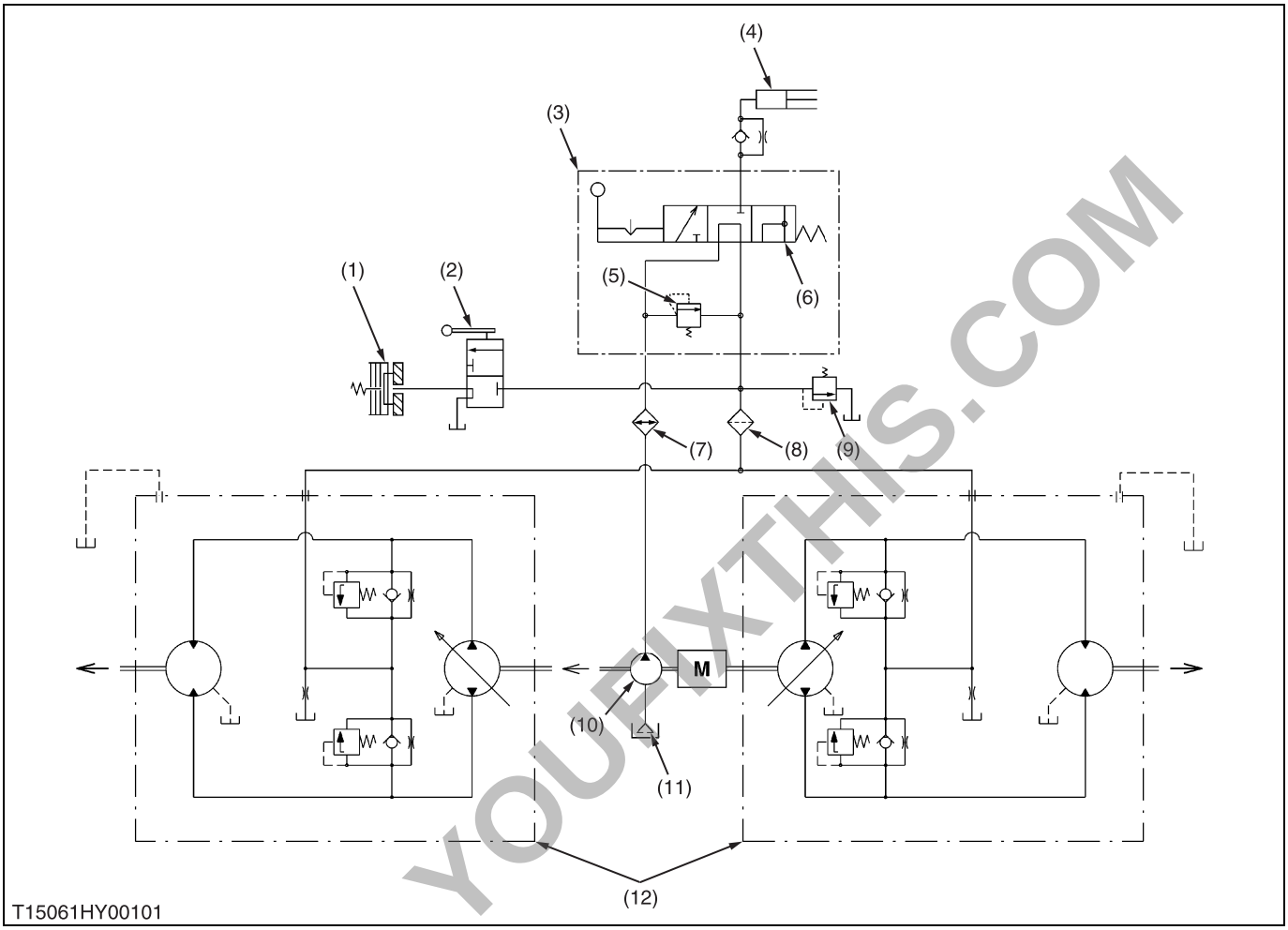


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1. HYDRAULIC CIRCUIT



(1) PTO Clutch
(2) PTO Clutch Valve
(3) Hydraulic Control Valve Assembly
(4) Hydraulic Cylinder
(5) Relief Valve
(6) Control Valve
(7) Oil Cooler (ZD28)
(8) Oil Filter
(9) Regulator Valve
(10) Hydraulic Pump
(11) Oil Strainer
(12) Hydrostatic Transmission

The hydraulic system of this machine is composed of a hydraulic pump (10), control valve (6), hydraulic cylinder (4) and other components.

This system has the following functions.

Oil is supplied by hydraulic pump (10) which is driven by engine.

Power from the input shaft (pump shaft) is distributed right and left with the bevel gears and drives each hydrostatic transmission (12).

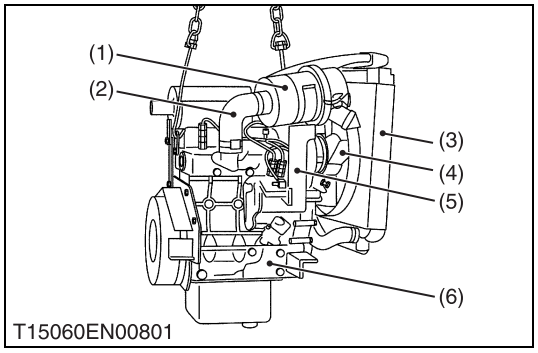
Moreover, oil from the hydraulic pump (10) is sent to the transmission center case through the control valve. On the other hand, oil is regulated with the regulator valve (9) to constant pressure and sent to the hydrostatic transmission (12) and PTO clutch (1).

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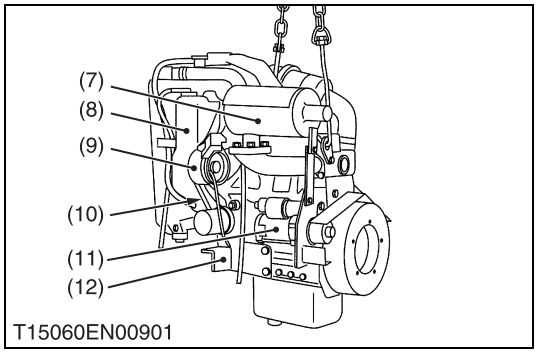
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(2) Disassembling and Assembling

(A) Cylinder Head and Valves



T15060EN00801



T15060EN00901

Dynamo, Fan Belt and Muffler

1. Disconnect the radiator hoses and separate the radiator (3) with recovery tank (8) from engine assembly.
2. Remove the cooling fan (4) and fan pulley.
3. Remove the dynamo (9) and fan belt (10).
4. Remove the muffler (7).
5. Remove the starter (11).
6. Disconnect the inlet pipe (2), air cleaner (1) and air cleaner stay (5).
7. Remove the wire bracket.
8. Remove the engine support LH (12) and RH (6).

(When reassembling)

- Check to see that there are no cracks on the belt surface.

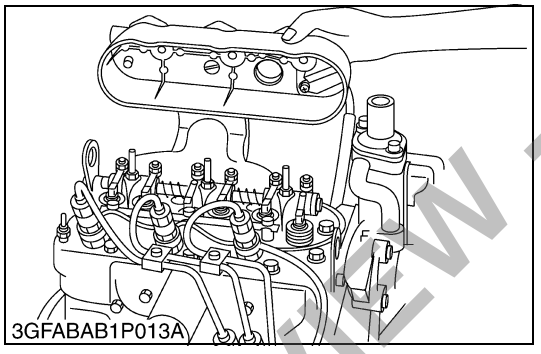
■ **IMPORTANT**

- **After reassembling the fan belt, be sure to adjust the fan belt tension.**

Tightening torque	Engine support mounting screw	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft-lbs

(1) Air Cleaner
(2) Inlet Pipe
(3) Radiator
(4) Cooling Fan
(5) Air Cleaner Stay
(6) Engine Support RH
(7) Muffler
(8) Recovery Tank
(9) Dynamo
(10) Fan Belt
(11) Starter
(12) Engine Support LH

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Cylinder Head Cover

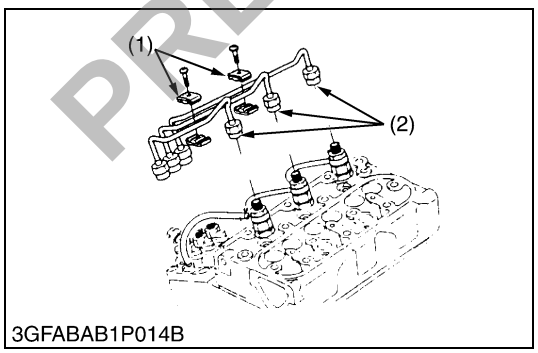
1. Remove the head cover cap nuts.
2. Remove the cylinder head cover.

(When reassembling)

- Check to see if the cylinder head cover gasket is not defective.
- Apply engine oil to the cylinder head cover cap nuts. And tighten them.

Tightening torque	Cylinder head cover cap nut	D782	3.9 to 5.9 N·m 0.4 to 0.6 kgf·m 2.9 to 4.3 ft-lbs
		D1105	6.9 to 8.8 N·m 0.7 to 0.9 kgf·m 5.1 to 6.5 ft-lbs

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Injection Pipes

1. Loosen the screws on the pipe clamps (1).
2. Detach the injection pipes (2).

(When reassembling)

- Blow out dust from the pipes with compressed air. Then reassemble the pipes in the reverse order.

Tightening torque	Injection pipe retaining nut	24.5 to 34.3 N·m 2.5 to 3.5 kgf·m 18.1 to 25.3 ft-lbs

(1) Pipe Clamp
(2) Injection Pipe

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4. TIGHTENING TORQUES

Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-9.)

Item	Size × Pitch	N·m	kgf·m	ft-lbs
Starter **M** terminal nut	M6 × 1.0	9.8 to 13.7	1.0 to 1.4	7.2 to 10.1
Universal joint mounting screw	M8 × 1.25	26.0 to 28.0	2.7 to 2.9	19.2 to 20.7
Engine support mounting screw	M10 × 1.25	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
Engine mounting nut	M8 × 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Cushion mounting nut	M8 × 1.25	17.6 to 20.6	1.8 to 2.1	13.0 to 15.2

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[D782-E-XFM5]

Item	Size × Pitch	N·m	kgf·m	ft-lbs
Cylinder head screw	M8 × 1.25	37.2 to 42.1	3.8 to 4.3	28.0 to 31.7
* Cylinder head cover cap nut	M6 × 1.0	3.9 to 5.9	0.4 to 0.6	2.9 to 4.3
Injection pipe retaining nut	M12 × 1.5	24.5 to 34.3	2.5 to 3.5	18.1 to 25.3
Nozzle holder assembly	M20 × 1.5	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Overflow pipe assembly retaining nut (nozzle)	M12 × 1.5	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Glow plug	M8 × 1.0	7.8 to 14.7	0.8 to 1.5	5.8 to 10.8
* Rocker arm bracket nut	M6 × 1.0	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Fan drive pulley retaining screw	M12 × 1.5	117.6 to 127.4	12.0 to 13.0	86.8 to 94.0
* Idle gear shaft mounting screw	M6 × 1.0	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Connecting rod screw	M7 × 0.75	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
* Flywheel bolt	M10 × 1.25	53.9 to 58.8	5.5 to 6.0	39.8 to 43.4
* Main bearing case screw 2	M7 × 1.0	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
* Main bearing case screw 1	M8 × 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
(D782)	M6 × 1.0	12.7 to 15.7	1.3 to 1.6	9.4 to 11.6
Oil pressure switch	PT 1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Nozzle holder		34.3 to 39.2	3.5 to 4.0	25.3 to 28.9

■ **NOTE**

- **In removing and applying the bolts and nuts marked with " * ", a pneumatic wrench or similar pneumatic tool, if employed, must be used with enough care not to get them sized.**
- **For * marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.**
- **The letter "M" in Size × Pitch means that the screw, bolt or nut dimension stands for metric. The size is the nominal outside diameter in mm of the threads. The pitch is the nominal distance in mm between two threads.**

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1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Engine Does Not Start	• No fuel	Replenish fuel	–
	• Air in the fuel system	Bleed fuel system	–
	• Water in the fuel system	Change fuel and replace fuel system	–
	• Fuel pipe clogged	Clean fuel pipe	–
	• Fuel filter clogged	Replace fuel filter	G-33
	• Excessively high viscosity of fuel or engine oil at low temperature	Use specified fuel or engine oil	G-7
	• Fuel with low cetane number	Use specified fuel	G-7
	• Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	1-S28
	• Incorrect injection timing	Adjust injection timing	1-S71
	• Fuel camshaft worn	Replace fuel camshaft	1-S33, S35
	• Injection nozzle clogged	Clean injection nozzle	1-S74
	• Injection pump malfunctioning	Repair or replace injection pump	1-S31, S35
	• Seizure of crankshaft, camshaft, piston, cylinder or bearing	Replace crankshaft, camshaft, piston, cylinder or bearing	1-S39, S40
	• Compression leak from cylinder	Replace head gasket, tighten cylinder head screw, glow plug and nozzle holder	1-S30 1-S32, S36
	• Improper valve timing	Correct valve timing	1-S39, S65
	• Piston ring and cylinder worn	Replace piston ring and bore oversize cylinder	1-S27
	• Excessive valve clearance	Adjust valve clearance	G-27
(Starter Does Not Run)	• Battery discharged	Charge battery	5-S12
	• Starter malfunctioning	Repair or replace starter	G-37
	• Slow blow fuse blown	Replace slow blow fuse	5-S8
	• Main switch malfunctioning	Repair or replace main switch	5-S10
	• PTO switch defective	Replace PTO switch	5-S10
	• Parking brake switch defective	Replace brake switch	5-S10
	• Motion control lever switch defective	Replace reverse switch or adjust reverse switch gap	5-S10
	• Seat switch defective	Replace seat switch	–
	• Wiring harness disconnected	Connect wiring harness	

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2. SERVICING SPECIFICATIONS [D782-E-XFM5]

[1] ENGINE BODY

Item		Factory Specification	Allowable Limit
Cylinder Head Surface	Flatness	–	0.05 mm 0.0020 in.
Top Clearance		0.50 to 0.70 mm 0.0197 to 0.0276 in.	–
Compression Pressure		2.84 to 3.24 MPa 29.0 to 33.0 kgf/cm^2 412 to 469 psi	2.26 MPa 23.0 kgf/cm^2 327 psi
Variance among Cylinders		–	10 % or less
Valve Clearance (Cold)		0.145 to 0.185 mm 0.00571 to 0.00728 in.	–
Valve Seat	Width	2.12 mm 0.0835 in.	–
Valve Seat	Angle	0785 rad 45°	–
Valve Face	Angle	0785 rad 45°	–
Valve Recessing		– 0.10 to 0.10 mm – 0.0039 to 0.0039 in.	0.3 mm 0.0118 in.
Valve Stem to Valve Guide	Clearance	0.030 to 0.057 mm 0.00118 to 0.00224 in.	0.10 mm 0.0039 in.
Valve Stem	O.D.	5.968 to 5.980 mm 0.23496 to 0.23543 in.	–
Valve Guide	I.D.	6.010 to 6.025 mm 0.23661 to 0.23720 in.	–
Valve Timing (Intake Valve)	Open	0.35 rad (20°) before T.D.C.	–
	Close	0785 rad (45°) after B.D.C.	–
Valve Timing (Exhaust Valve)	Open	0.89 rad (50°) before B.D.C.	–
	Close	0.26 rad (15°) after T.D.C.	–

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4. LUBRICANTS, FUEL AND COOLANT

No.	Place		Capacity			Lubricants, fuel and coolant
			ZD21N-EC	ZD21-EC	ZD28-EC	
1	Fuel		30 L 7.9 U.S.gals. 6.6 Imp.gals.			No. 2-D diesel fuel No. 1-D diesel fuel if temperature is below – 10 °C (14 °F)
2	Coolant	Cooling system	2.6 L 2.7 U.S.qts. 2.3 Imp.qts.		3.8 L 4.0 U.S.qts. 3.3 Imp.qts.	Fresh clean water (soft water) with anti-freeze
		Recovery tank	0.25 L 0.26 U.S.qts. 0.22 Imp.qts.			
3	Engine crankcase		3.5 L* 3.7 U.S.qts. 3.1 Imp.qts.		3.4 L* 3.6 U.S.qts. 3.0 Imp.qts.	Engine oil : API Service Classification CC or CD Below 0 °C (32 °F) : SAE10W, 10W-30 or 10W-40 0 to 25 °C (32 to 77 °F): SAE20, 10W-30 or 10W-40 Above 25 °C (77 °F): SAE30, 10W-30 or 10W-40
4	Transmission case		3.2 L 3.4 U.S.qts. 2.8 Imp.qts.			KUBOTA UDT or SUPER UDT fluid**
5	Transmission case with filter & hose		4.0 L 4.2 U.S.qts. 3.5 Imp.qts.			
6	Rear axle case		1.8 L each 1.9 U.S.qts. each 1.6 Imp.qts. each			
7	Mower gear case		0.40 L 0.42 U.S.qts. 0.35 Imp.qts.			

* Oil amount when the oil level is the upper of the oil level gauge.
** KUBOTA original transmission hydraulic fluid

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6. MAINTENANCE CHECK LIST

No.	Items \ Period		Service interval														Reference page
			50	100	150	200	250	300	350	400	450	500	550	600	After since		
1	Engine oil	Change	★	☆		☆		☆		☆		☆		☆	every 100 hr		G-17
2	Engine oil filter	Replace	★			☆				☆				☆	every 200 hr		G-18
3	Transmission fluid	Change				★				☆				☆	every 200 hr		G-21
4	Transmission oil filter	Replace	★			☆				☆				☆	every 200 hr		G-18
5	Transmission strainer	Clean				★				☆				☆	every 200 hr		G-20
6	Rear axle gear case (RH & LH) fluid	Change				★				☆				☆	every 200 hr		G-21
7	Front axle pivot	Adjust		★		☆				☆				☆	every 200 hr		G-19
8	Safety device	Check	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 hr		G-22
9	Greasing (without mower)	–	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 hr		G-24
10	Mower gear box oil	Check	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 150 hr		G-26
		Change			☆			☆			☆			☆	every 150 hr		–
11	Air cleaner element	Clean	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 hr	*1	G-26
		Replace													every 1 year		–
12	Battery condition	Check		☆		☆		☆		☆		☆		☆	every 100 hr		G-26
13	Fan belt	Adjust		☆		☆		☆		☆		☆		☆	every 100 hr		G-28
14	Parking brake	Adjust		☆		☆		☆		☆		☆		☆	every 100 hr		G-29
15	Fuel filter element	Check		☆		☆		☆		☆		☆		☆	every 100 hr		G-28
		Replace								☆					every 400 hr		G-33
16	Fuel line	Check		☆		☆		☆		☆		☆		☆	every 100 hr		G-28
		Replace													every 2 years		–

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■ IMPORTANT

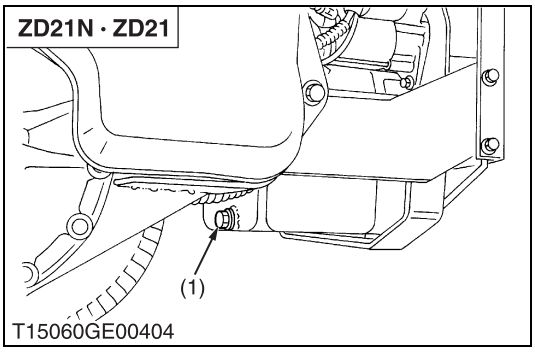
• The jobs indicated by ★ must be done initially.

***1 This maintenance should be done daily more often in dusty condition than in normal conditions. Suggested cleaning interval is every 100 hours in normal conditions.**

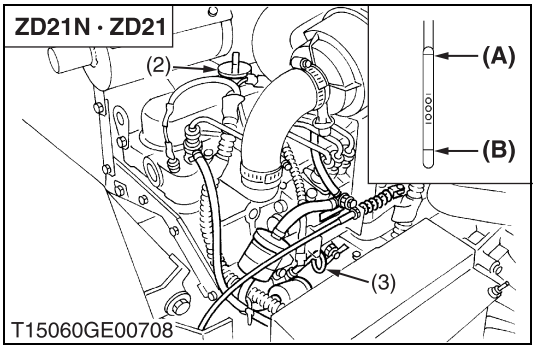
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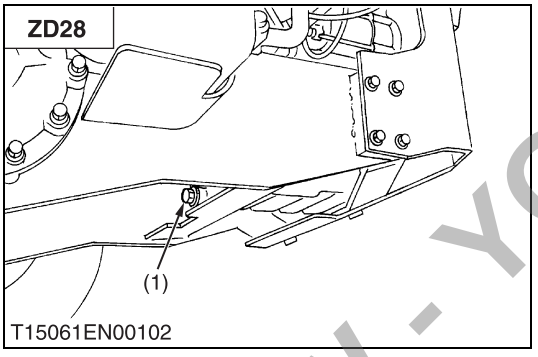
[2] CHECK POINTS OF INITIAL 50 HOURS



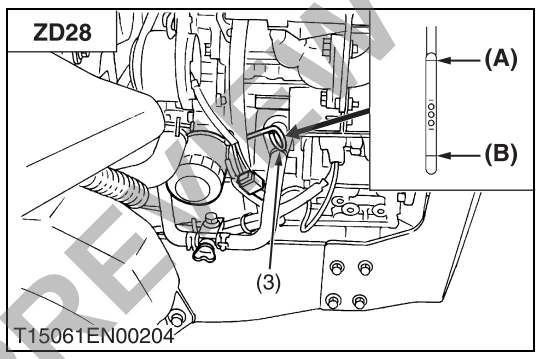
T15060GE00404



T15060GE00708



T15061EN00102



T15061EN00204

Changing Engine Oil

CAUTION

- **Be sure to stop the engine before changing oil.**

1. Start and warm up the engine for approx. 5 minutes.
2. Place an oil pan underneath the engine.
3. To drain the used oil, remove the drain plug (1) at the bottom of the engine and drain the oil completely.
4. Screw in the drain plug (1).
5. Fill new oil up to upper line on the dipstick (3).

■ **IMPORTANT**

- **When using an oil of different manufacture or viscosity from the previous one, remove all of the old oil.**
- **Never mix two different type of oil.**
- **Use the proper SAE engine oil according to ambient temperatures.**
  Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-7.)

Engine oil capacity	ZD21N ZD21	3.5 L 3.7 U.S.qts. 3.1 Imp.qts.
	ZD28	3.4 L 3.6 U.S.qts. 3.0 Imp.qts.

(1) Drain Plug
(2) Oil Inlet Plug
(3) Dipstick
(A) Upper Level
(B) Lower Level

W1030749

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