

SERVICE MANUAL

W190C TIER 2 Wheel Loader

Part number 84525132

English

June 2011

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Section 1001

GENERAL TORQUE SPECIFICATIONS

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TORQUE SPECIFICATIONS - DECIMAL HARDWARE

Use the torques in this chart when special torques are not given. These torques apply to fasteners with both UNC and UNF threads as received from suppliers dry, or when lubricated with engine oil. Not applicable if special graphities, Molydisulfide greases, or other extreme pressure lubricants are used.

Grade 5 Bolts, Nuts, and Studs		
		
Size	Pound-Inches	Newton metres
1/4 inch	108 to 132	12 to 15
5/16 inch	204 to 252	23 to 28
3/8 inch	420 to 504	48 to 57
Size	Pound-Feet	Newton metres
7/16 inch	54 to 64	73 to 87
1/2 inch	80 to 96	109 to 130
9/16 inch	110 to 132	149 to 179
5/8 inch	150 to 180	203 to 244
3/4 inch	270 to 324	366 to 439
7/8 inch	400 to 480	542 to 651
1.0 inch	580 to 696	787 to 944
1-1/8 inch	800 to 880	1085 to 1193
1-1/4 inch	1120 to 1240	1519 to 1681
1-3/8 inch	1460 to 1680	1980 to 2278
1-1/2 inch	1940 to 2200	2631 to 2983

Grade 8 Bolts, Nuts, and Studs		
		
Size	Pound-Inches	Newton metres
1/4 inch	144 to 180	16 to 20
5/16 inch	288 to 348	33 to 39
3/8 inch	540 to 648	61 to 73
Size	Pound-Feet	Newton metres
7/16 inch	70 to 84	95 to 114
1/2 inch	110 to 132	149 to 179
9/16 inch	160 to 192	217 to 260
5/8 inch	220 to 264	298 to 358
3/4 inch	380 to 456	515 to 618
7/8 inch	600 to 720	814 to 976
1.0 inch	900 to 1080	1220 to 1465
1-1/8 inch	1280 to 1440	1736 to 1953
1-1/4 inch	1820 to 2000	2468 to 2712
1-3/8 inch	2380 to 2720	3227 to 3688
1-1/2 inch	3160 to 3560	4285 to 4827
NOTE: Use thick nuts with Grade 8 bolts.		

TORQUE SPECIFICATIONS - METRIC HARDWARE

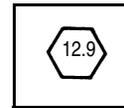
Use the following torques when specifications are not given.

These values apply to fasteners with coarse threads as received from supplier, plated or unplated, or when lubricated with engine oil. These values do not apply if graphite or Molydisulfide grease or oil is used.

Grade 8.8 Bolts, Nuts, and Studs		
		
Size	Pound-Inches	Newton metres
M4	24 to 36	3 to 4
M5	60 to 72	7 to 8
M6	96 to 108	11 to 12
M8	228 to 276	26 to 31
M10	456 to 540	52 to 61
Size	Pound-Feet	Newton metres
M12	66 to 79	90 to 107
M14	106 to 127	144 to 172
M16	160 to 200	217 to 271
M20	320 to 380	434 to 515
M24	500 to 600	675 to 815
M30	920 to 1100	1250 to 1500
M36	1600 to 1950	2175 to 2600

Grade 10.9 Bolts, Nuts, and Studs		
		
Size	Pound-Inches	Newton metres
M4	36 to 48	4 to 5
M5	84 to 96	9 to 11
M6	132 to 156	15 to 18
M8	324 to 384	37 to 43
Size	Pound-Feet	Newton metres
M10	54 to 64	73 to 87
M12	93 to 112	125 to 150
M14	149 to 179	200 to 245
M16	230 to 280	310 to 380
M20	450 to 540	610 to 730
M24	780 to 940	1050 to 1275
M30	1470 to 1770	2000 to 2400
M36	2580 to 3090	3500 to 4200

Grade 12.9 Bolts, Nuts, and Studs



Usually the torque values specified for grade 10.9 fasteners can be used satisfactorily on grade 12.9 fasteners.

TORQUE SPECIFICATIONS - STEEL HYDRAULIC FITTINGS

37 Degree Flare Fitting			
Tube OD Hose ID	Thread Size	Pound- Inches	Newton metres
1/4 inch 6.4 mm	7/16-20	72 to 144	8 to 16
5/16 inch 7.9 mm	1/2-20	96 to 192	11 to 22
3/8 inch 9.5 mm	9/16-18	120 to 300	14 to 34
1/2 inch 12.7 mm	3/4-16	180 to 504	20 to 57
5/8 inch 15.9 mm	7/8-14	300 to 696	34 to 79
Tube OD Hose ID	Thread Size	Pound- Feet	Newton metres
3/4 inch 19.0 mm	1-1/16-12	40 to 80	54 to 108
7/8 inch 22.2 mm	1-3/16-12	60 to 100	81 to 135
1.0 inch 25.4 mm	1-5/16-12	75 to 117	102 to 158
1-1/4 inch 31.8 mm	1-5/8-12	125 to 165	169 to 223
1-1/2 inch 38.1 mm	1-7/8-12	210 to 250	285 to 338

Straight Threads with O-ring			
Tube OD Hose ID	Thread Size	Pound- Inches	Newton metres
1/4 inch 6.4 mm	7/16-20	144 to 228	16 to 26
5/16 inch 7.9 mm	1/2-20	192 to 300	22 to 34
3/8 inch 9.5 mm	9/16-18	300 to 480	34 to 54
1/2 inch 12.7 mm	3/4-16	540 to 804	57 to 91
Tube OD Hose ID	Thread Size	Pound- Feet	Newton metres
5/8 inch 15.9 mm	7/8-14	58 to 92	79 to 124
3/4 inch 19.0 mm	1-1/16-12	80 to 128	108 to 174
7/8 inch 22.2 mm	1-3/16-12	100 to 160	136 to 216
1.0 inch 25.4 mm	1-5/16-12	117 to 187	159 to 253
1-1/4 inch 31.8 mm	1-5/8-12	165 to 264	224 to 357
1-1/2 inch 38.1 mm	1-7/8-12	250 to 400	339 to 542

Split Flange Mounting Bolts		
Size	Pound- Inches	Newton metres
5/16-18	180 to 240	20 to 27
3/8-16	240 to 300	27 to 34
7/16-14	420 to 540	47 to 61
Size	Pound- Feet	Newton metres
1/2-13	55 to 65	74 to 88
5/8-11	140 to 150	190 to 203

TORQUE SPECIFICATIONS - STEEL HYDRAULIC FITTINGS

O-ring Face Seal End					O-ring Boss End Fitting or Lock Nut		
Nom. SAE Dash Size	Tube OD	Thread Size	Pound- Inches	Newton metres	Thread Size	Pound- Inches	Newton metres
-4	1/4 inch 6.4 mm	9/16-18	120 to 144	14 to 16	7/16-20	204 to 240	23 to 27
-6	3/8 inch 9.5 mm	11/16-16	216 to 240	24 to 27	9/16-18	300 to 360	34 to 41
-8	1/2 inch 12.7 mm	13/16-16	384 to 480	43 to 54	3/4-16	540 to 600	61 to 68
					Thread Size	Pound- Feet	Newton metres
-10	5/8 inch 15.9 mm	1-14	552 to 672	62 to 76	7/8-14	60 to 65	81 to 88
Nom. SAE Dash Size	Tube OD	Thread Size	Pound- Feet	Newton metres	1-1/16-12	85 to 90	115 to 122
					1-3/16-12	95 to 100	129 to 136
-12	3/4 inch 19.0 mm	1-3/16-12	65 to 80	90 to 110	1-5/16-12	115 to 125	156 to 169
-14	7/8 inch 22.2 mm	1-3/16-12	65 to 80	90 to 110	1-5/8-12	150 to 160	203 to 217
-16	1.0 inch 25.4 mm	1-7/16-12	92 to 105	125 to 140	1-7/8-12	190 to 200	258 to 271
-20	1-1/4 inch 31.8 mm	1-11/16-12	125 to 140	170 to 190			
-24	1-1/2 inch 38.1 mm	2-12	150 to 180	200 to 254			

Section 1002

FLUIDS AND LUBRICANTS

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W190C - CAPACITIES AND LUBRICANTS

Engine Oil

Capacity with Filter Change	13.25 liters (14 U.S. Quarts)
Total system capacity	15.1 liters (16 U.S. Quarts)
Type of oil	AMBRA Mastergold (SAE 15W-40) - see engine oil recommendations on page 4

Engine Cooling System

Capacity	30 liters (32 U.S. Quarts)
Type of Coolant	50% water and 50% Ethylene Glycol

Fuel Tank

Capacity	288 liters (76 U.S. Gallons)
Type of Fuel.....	See Diesel fuel specifications on page 5

DEF (Diesel Exhaust Fluid) Tank

Capacity	41.3 liters (43.6 U.S. Quarts)
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Hydraulic System

Hydraulic Reservoir Refill Capacity	90.8 liters (24.0 U.S. Gallons)
Total System Capacity	178 liters (47.0 U.S. Gallons)
Type of Oil	AMBRA Hydrosystem 46HV®

Transmission

Refill Capacity with Filter Change	36 liters (38 U.S. Quarts)
Type of Oil	AMBRA Supergold (SAE 10W-30)

Axles

Capacity	
Front.....	40.0 liters (42.3 U.S. Quarts)
Rear	40.0 liters (42.3 U.S. Quarts)
Type of Lubricant.....	AMBRA TRX Transaxle Fluid

NOTE: *DO NOT use an alternate oil in the axles. The brake components in the axles could be damaged as a result of using an alternate oil. Machines are shipped from the factory with break-in oil.*

Brake System

Type of Fluid (Same as Hydraulic System).....	AMBRA Hydrosystem 46HV®
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Grease Fittings

Grease fittings as required by maintenance schedule.....	AMBRA GR 75 MD®
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ENGINE OIL RECOMMENDATIONS

AMBRA Mastergold (SAE 15W-40) engine oil is recommended for use in your engine. AMBRA Mastergold (SAE 15W-40) engine oil will lubricate your engine correctly under all operating conditions.

If AMBRA Mastergold (SAE 15W-40) Multi-Viscosity Oil is not available, use only oil meeting API engine oil service category CH-4 (preferred) or CG-4.

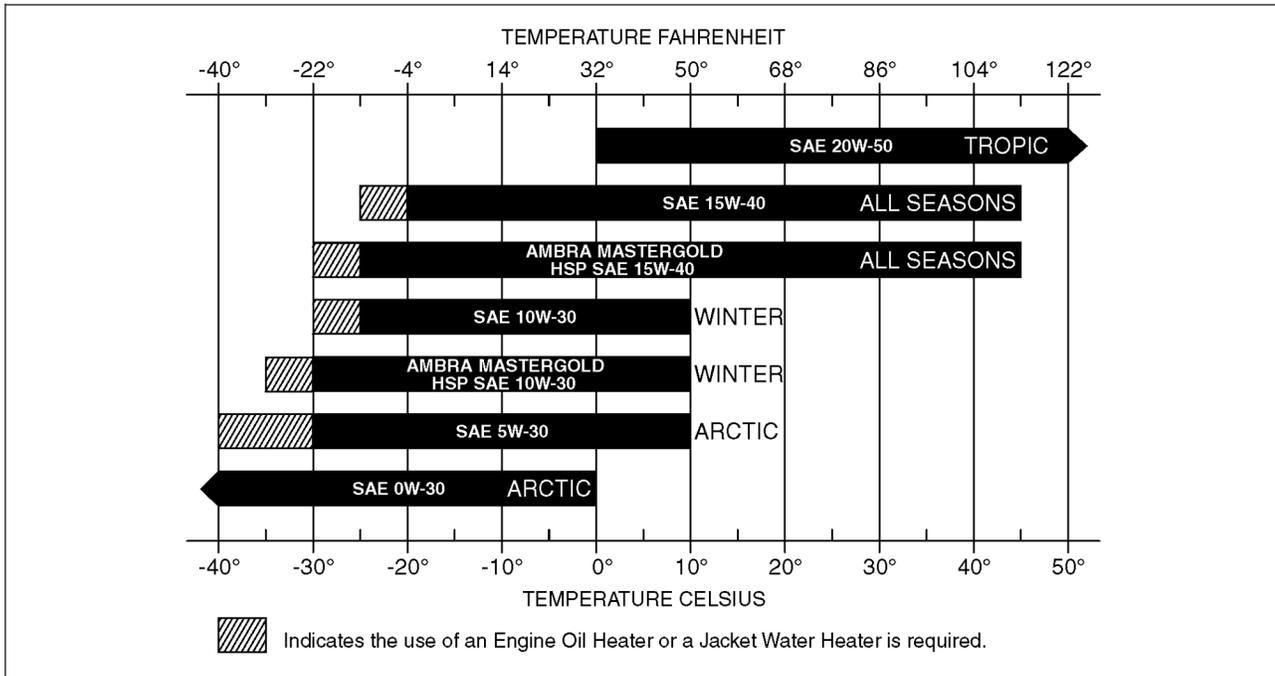


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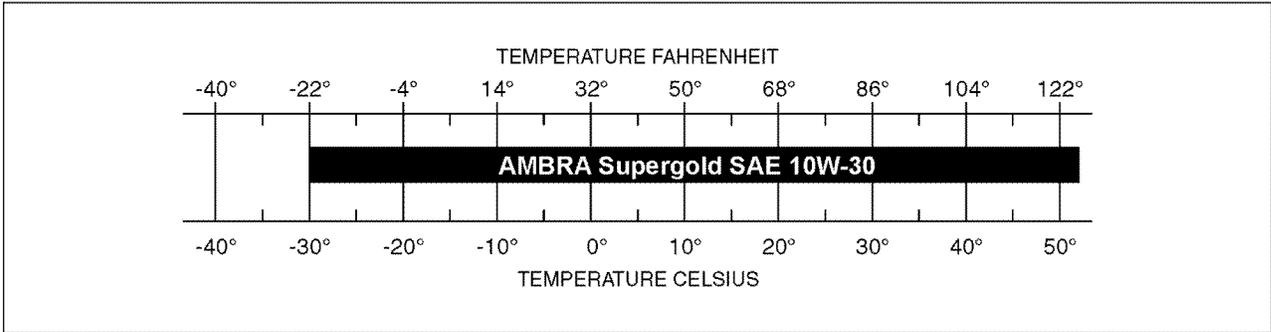


See the chart below for recommended viscosity at ambient air temperature ranges.

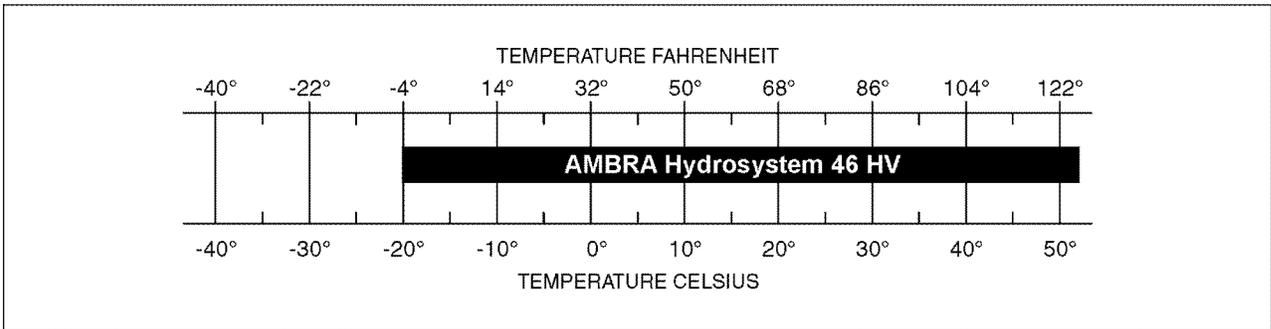
NOTE: Do not put performance additives or other oil additive products in the engine crankcase. The oil change intervals given in this manual are according to tests with AMBRA Mastergold (SAE 15W-40) lubricants.



TRANSMISSION TEMPERATURE CHART



HYDRAULIC/BRAKE SYSTEM - TEMPERATURE RANGES



DIESEL FUEL SYSTEM

Use No. 2 diesel fuel in the engine of this machine. The use of other fuels can cause the loss of engine power and high fuel consumption.

In very cold temperatures, a mixture of No. 1 and No. 2 diesel fuels is temporarily permitted. See the following Note.

NOTE: *See your fuel dealer for winter fuel requirements in your area. If the temperature of the fuel lowers below the cloud point (wax appearance point), wax crystals in the fuel will restrict the fuel filter and cause the engine to lose power or not start.*

The diesel fuel used in this machine must meet the specifications as shown below in, "Specifications for Acceptable No. 2 Diesel Fuel", or "Specification D975-81" of the American Society for Testing and Materials.

Specifications for Acceptable No. 2 Diesel Fuel

API gravity, minimum	34
Flash point, minimum	60°C (140°F)
Cloud point (wax appearance point), maximum	-20°C (-5°F) See Note above
Pour point, maximum	-26°C (-15°F) See Note above
Distillation temperature, 90% point	282 to 338°C (540 to 640°F)
Viscosity, at 38°C (100°F)	
Centistokes	2.0 to 4.3
Cetane number, minimum	43 (45 to 55 for winter or high altitudes)
Water and sediment, by volume, maximum	0.05%

Fuel Storage

If you keep fuel in storage for a period of time, you can get foreign material or water in the fuel storage tank. Many engine problems are caused by water in the fuel.

Keep the fuel storage tank outside and keep the fuel as cool as possible. Remove water from the storage container at regular periods of time.

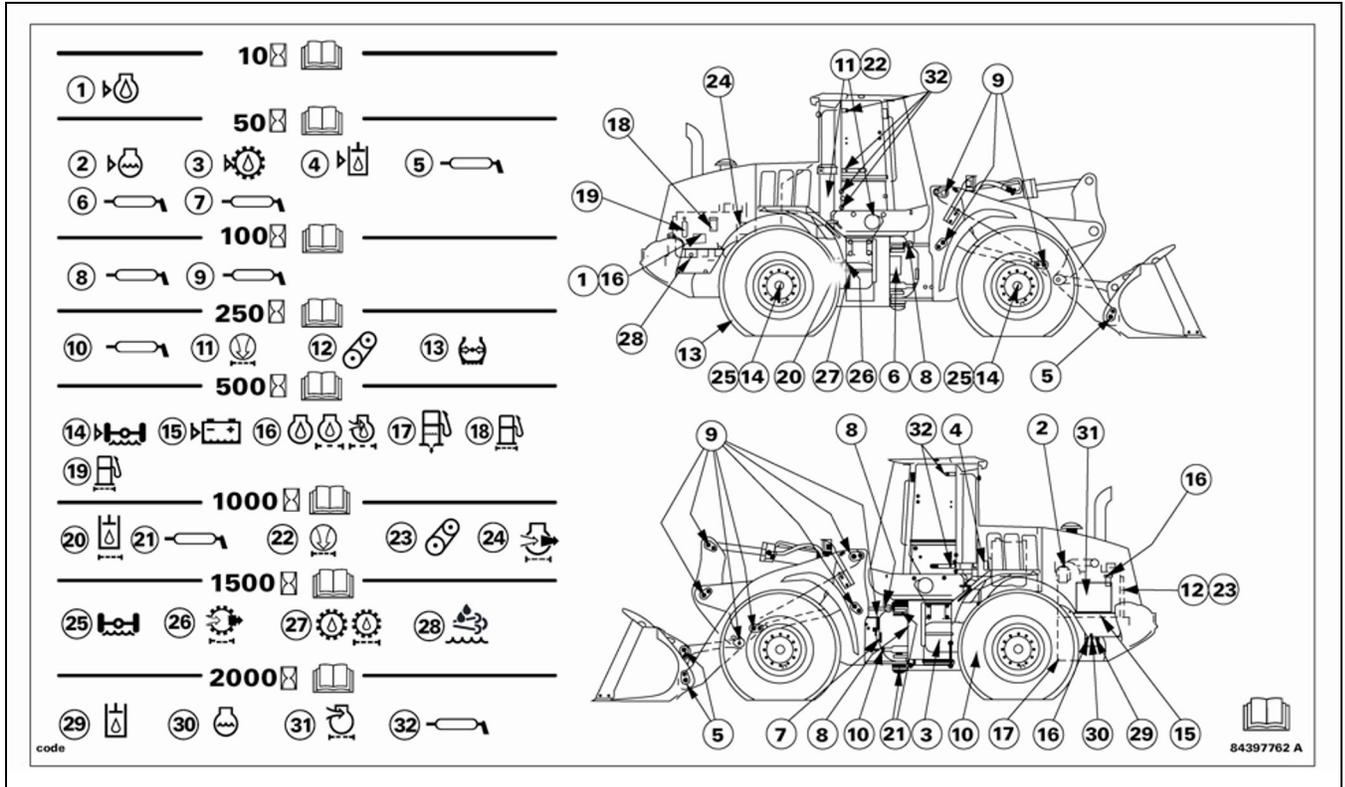
Fill the fuel tank at the end of the daily operating period to prevent condensation in the fuel tank.

MAINTENANCE SCHEDULE

SERVICE INTERVAL	ITEM NUMBER	SERVICE POINTS	Initial Service	FREQUENCY IN HOURS							
				CHECK	CLEAN	CHANGE	DRAIN	LUBRICATE	REPLACE	ADJUST	
Variable Periodic (*)	2	Radiator Coolant Level		*							
	13	Tires		*							
	16	Hydraulic Filter		*							
	12	Alternator, AC, Drive Belt		*							
	31	Air cleaner		*	*						
	19	Bleed Fuel Filter of Condensation					*				
	XX	Fire extinguisher		*							
Every 10 Hours	1	Check Engine Oil Level		10							
Every 50 Hours	13	Check Engine Coolant Level		50							
	3	Check Transmission Oil Level		50							
	4	Check Hydraulic Oil Level		50							
	5 & 6	Grease Bucket Mounting Fittings						50			
	7	Grease machine and attachments						50			
First 100 Hours	16	Change Engine Oil and Filters	100								
	18	Replace Fuel Filters	100								
	20	Change Hydraulic Filter	100								
	25	Change Oil in Axles	100								
	13	Check wheel torque		100							
Every 100 Hours	8	Lubricate The Steering Cylinder Pivots - Rod And Closed End (4 Fittings)						100			
	9	Grease Front Drive Shaft Support Bearing						100			
	10	Lubricate Loader Lift & Cylinder Pivots (10) Z-bar						100			
	10	Lubricate Loader Lift & Cylinder Pivots (18) XT						100			
Every 250 Hours	11	Check Cab Air Filter		250							
	14	Check Tire Pressure & Wheel Torque	4	250							
	12	Check Drive Belt		250							
	XX	Trans Clutch Calibration (See Section 6002)	250	1000							
Every 500 Hours	14	Check Axle Oil Level		500							
	15	Check Battery Electrolyte Level		500							
	16	Change Engine Oil and Filter				500					
	XX	Check ROPS		500							
	18	Drain Fuel Tank Condensation & Water Separator					500				
	19	Replace Fuel Filter							500		

Every 1000 Hours	20	Replace Hydraulic Oil filter						1000	
	21	Grease Articulation Fittings					1000		
	24	Change crankcase filter				1000		1000	
	23	Replace Drive Belt							
	11	Replace Cab Air Filter						1000	
	26	Change Transmission Oil and Filter				1000			
	XX	Check Injector Calibration		1000					
	XX	Check Valve Adjustment (Engine Manual)		1000					
	XX	Trans Clutch Calibration (See Section 6002)		1000					
Every 1500 Hours	21	Change Front & Rear Axle Oil				1500			
	26	Change Transmission Oil and Filter				1500			
Every 2000 Hours	29	Change Hydraulic Oil				2000			
	30	Change Coolant				2000			
	31	Replace Engine Air Cleaner						2000	
	32	Lubricate cab and door					2000		
	XX	Valve Clearance (Engine Manual)							2000
Every 6000 Hours	XX	Engine Injectors (Engine Manual)			6000				
	XX	Fuel Pump (Engine Manual)			6000				6000

MAINTENANCE POINTS



See your Operators manual for maintenance of safety related items and for detailed information of the service items on this chart. Operators and service manuals are available for this machine from your dealer.

If you operate the machine in severe conditions, lubricate and service the machine more frequently.

Section 1003

METRIC CONVERSION CHART

1003

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CONVERSION FACTORS

Metric to U.S.

	<u>MULTIPLY</u>	<u>BY</u>	<u>TO OBTAIN</u>
Area:	sq. meter hectare	10.763 91 2.471 05	square foot acre
Force:	newton newton	3.596 942 0.224 809	ounce force pound force
Length:	millimeter meter kilometer	0.039 370 3.280 840 0.621 371	inch foot mile
Mass:	kilogram	2.204 622	pound
Mass/Area:	kilogram/hectare	0.000 466	ton/acre
Mass/Energy:	gr/kW/hr.	0.001 644	lbs/hp/hr.
Mass/Volume:	kg/cubic meter	1.685 555	lb/cubic yd.
Power:	kilowatt	1.341 02	horsepower
Pressure:	kilopascal bar	0.145 038 14.50385	lb/sq. inch lb/sq. inch
Temperature:	degree C	1.8 x C +32	degree F
Torque:	newton meter newton meter	8.850 748 0.737 562	lb/inch lb/foot
Velocity:	kilometer/hr.	0.621 371	miles/hr.
Volume:	cubic centimeter cubic meter cubic meter milliliter litre litre litre litre	0.061 024 35.314 66 1.307 950 0.033 814 1.056 814 0.879 877 0.264 172 0.219 969	cubic inch cubic foot cubic yd. ounce (US fluid) quart (US liquid) quart (Imperial) gallon (US liquid) gallon (Imperial)
Volume/Time:	litre/min. litre/min.	0.264 172 0.219 969	gallon/min. (US liquid) gallon/min. (Imperial)

U.S. to Metric

	<u>MULTIPLY</u>	<u>BY</u>	<u>TO OBTAIN</u>
Area:	square foot acre	0.092 903 0.404 686	square meter hectare
Force:	ounce force pound force	0.278 014 4.448 222	newton newton
Length:	inch foot mile	25.4 * 0.304 8 * 1.609 344 *	millimeter meter kilometer
Mass:	pound ounce	0.453 592 28.35	kilogram gram
Mass/Area:	ton/acre	2241 702	kilogram/hectare
Mass/Energy:	lb/hp/hr	608.277 4	gr/kW/hr
Mass/Volume:	lb/cubic yd.	0.593 276	kg/cubic meter
Power:	horsepower	0.745 700	kilowatt
Pressure:	lbs/sq. in. lbs/sq. in. lbs/sq. in.	6.894 757 0.069 0.070 303	kilopascal bar kg/sq. cm
Temperature:	degree F	1.8 F - 32	degree C
Torque:	pound/inch pound/foot	0.112 985 1.355 818	newton meter newton meter
Velocity:	miles/hr.	1.609 344 *	kilometer/hr.
Volume:	cubic inch cubic foot cubic yard ounce (US fluid) quart (US liquid) quart (Imperial) gallon (US) gallons (Imperial)	16.387 06 0.028 317 0.764.555 29.573 53 0.946 353 1.136 523 3.785 412 4.546 092	cubic centimeter cubic meter cubic meter milliliter litre litre litre litre
Volume/Time:	gallon/min.	3.785 412	litre/min.

* = exact

Section 2000

ENGINE AND RADIATOR REMOVAL AND INSTALLATION

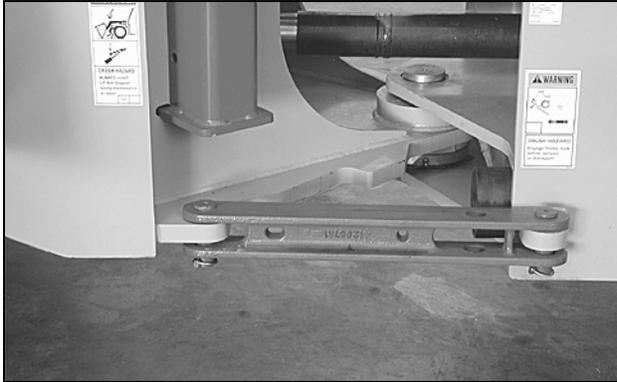
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ENGINE

Removal

STEP 1



BD03A040

Park machine on a level surface and lower bucket to ground. Put articulation lock in LOCKED position.

STEP 2

Stop engine. Actuate brake pedal several times to discharge brake accumulators. Put key switch in ON position and move loader control lever back and forth at least 30 times to release any pressure from hydraulic circuit. Put key switch in OFF position.

STEP 3

Slowly loosen the filler cap for hydraulic reservoir to release air pressure in hydraulic reservoir.

STEP 4



BD06F108

The master and hood raise switch are located by the battery box. Raise the hood with the hood lift motor. Put master disconnect switch in OFF position. Remove both battery covers and disconnect batteries from the machine.

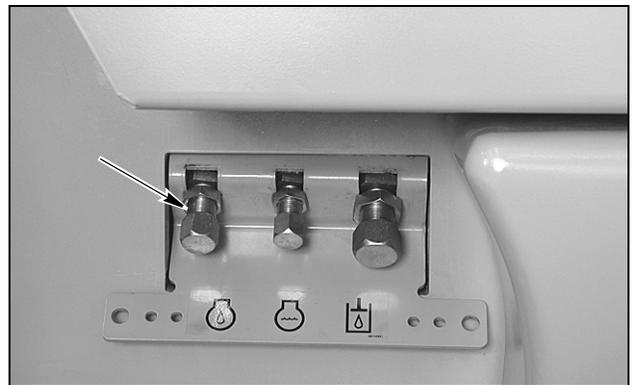
STEP 5



BD02N160

Put a 30 liter (32 U.S. quart) container below radiator drain. Remove radiator cap. Remove cap and drain coolant into container. Install cap after coolant has drained. Install radiator cap.

STEP 6



BD02N160

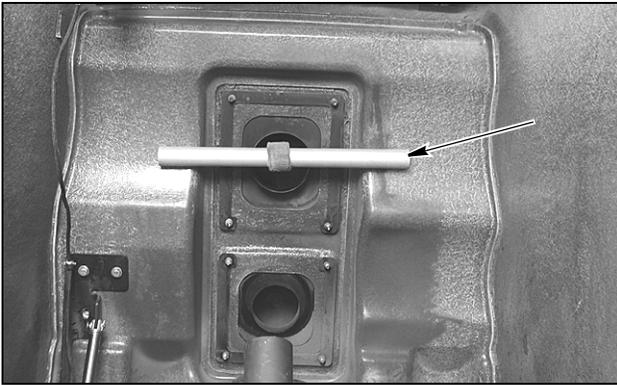
Put a 15.1 liter (16 U.S. quart) container below engine oil drain. Remove cap and drain oil into container. Install cap after oil has drained.

NOTE: After draining oil disconnect drain hose from frame for removal with engine.

STEP 7

Double up a nylon lifting strap (1) and slide through the exhaust stack (2) on the hood.

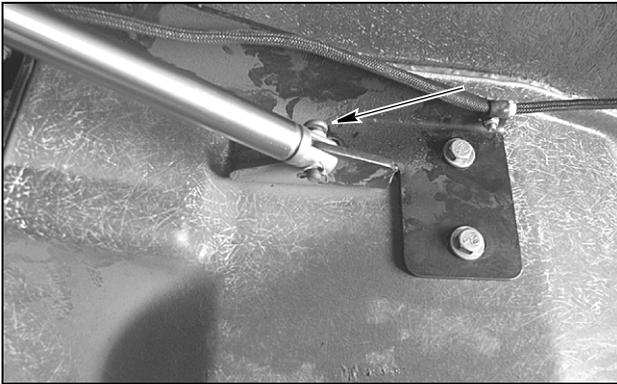
STEP 8



BD03A230

Place a solid steel bar through the strap, raise the hood and release tension on the lifting motor.

STEP 9



BD03A228

Remove the pin from the top of the lifting motor.

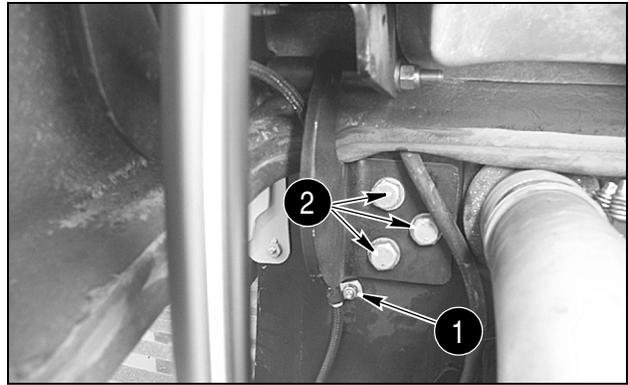
STEP 10



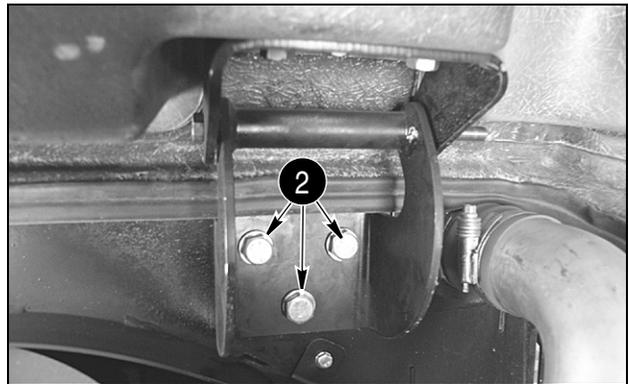
BD06F109

Tag and disconnect hood wiring harness connector from rear chassis wiring harness connector.

STEP 11



BD03A227



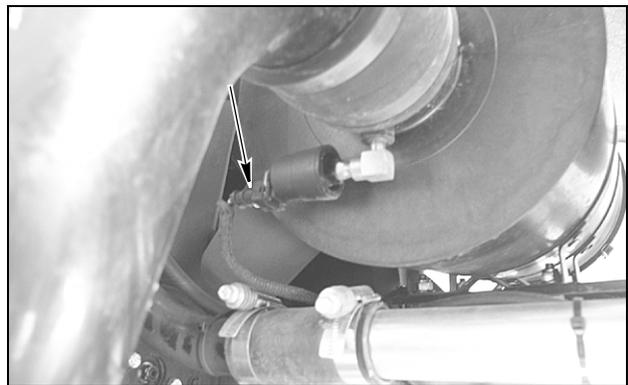
BD03A226

Remove mount bolt (1) and backup alarm wiring harness clamp from cooler housing. Have another person balance the hood and remove the hood hinge mounting bolts (2) from the cooler frame.

STEP 12

Carefully raise and remove hood from loader. Lower hood onto suitable platform and disconnect lifting equipment.

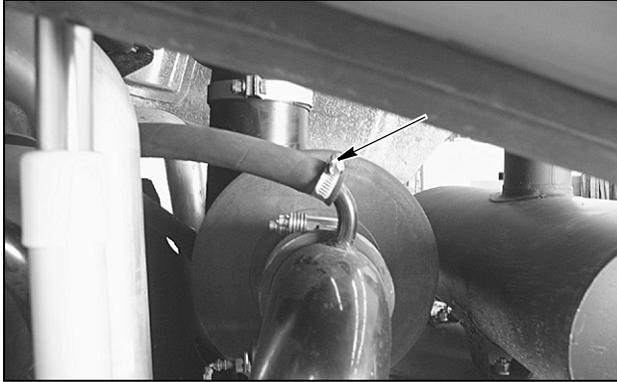
STEP 13



BD03A224

Tag and disconnect engine wiring harness connector from air filter restriction switch.

STEP 14



BD03A225

Loosen clamp on air cleaner intake hose and remove the crankcase ventilation hose.

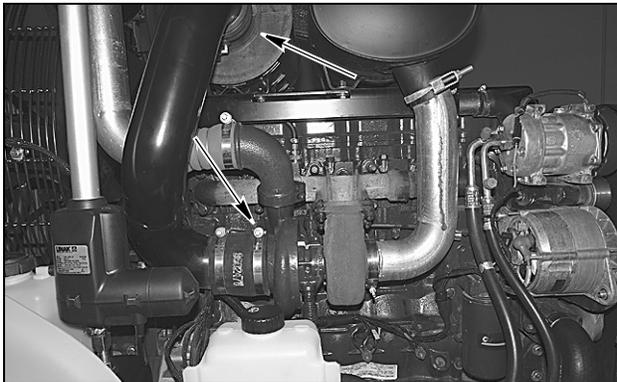
STEP 17



BD03A115

Loosen the clamp on the after cooler and remove the after cooler inlet hose from the machine.

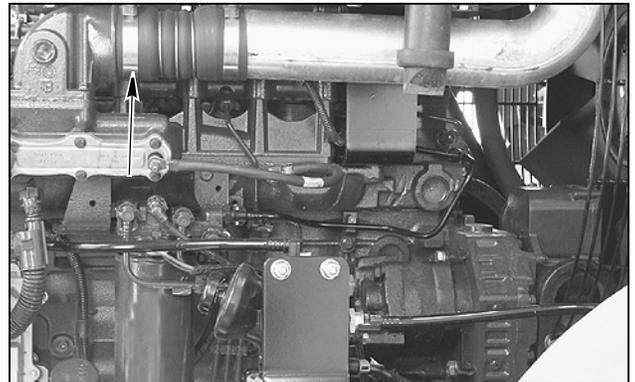
STEP 15



BD06F110

Loosen clamps on turbocharger and air cleaner, remove the intake hose.

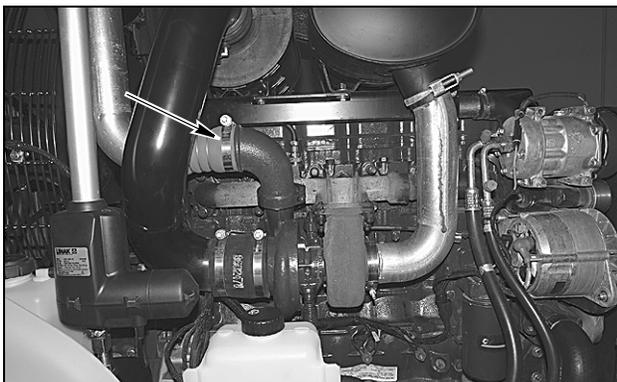
STEP 18



BD06F111

Loosen the clamp on the intake manifold for the after cooler output hose.

STEP 16



BD06F110

Loosen the clamp on the turbocharger for the after cooler inlet hose.

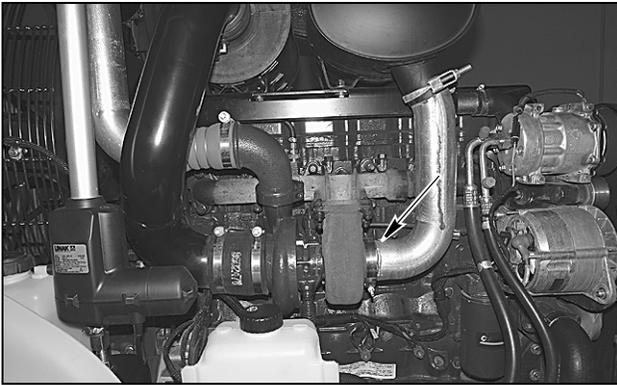
STEP 19



BD03A118

Loosen the clamp on the after cooler and remove the after cooler outlet hose from the machine.

STEP 20



BD06F110

Loosen the exhaust clamp from the turbocharger.

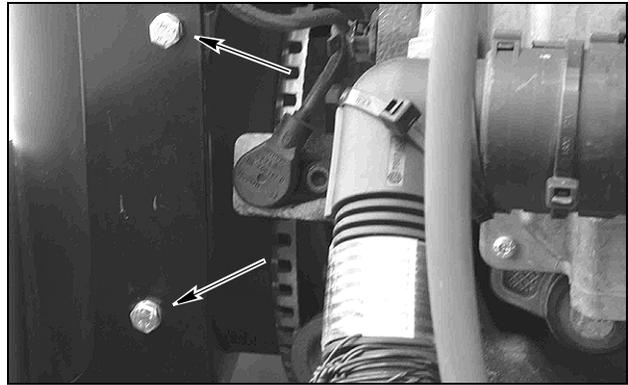
STEP 21



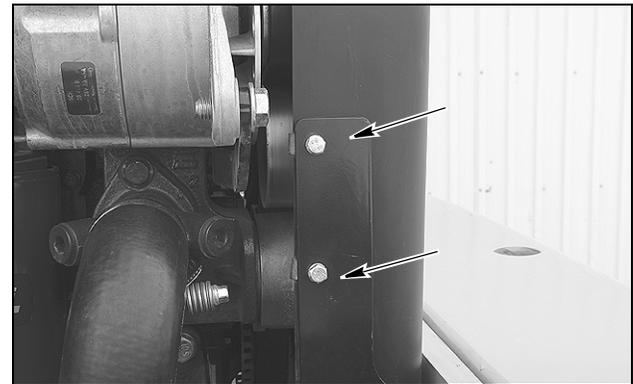
BD06F112

Remove the air cleaner and muffler from the bracket.

STEP 22



BD06F113

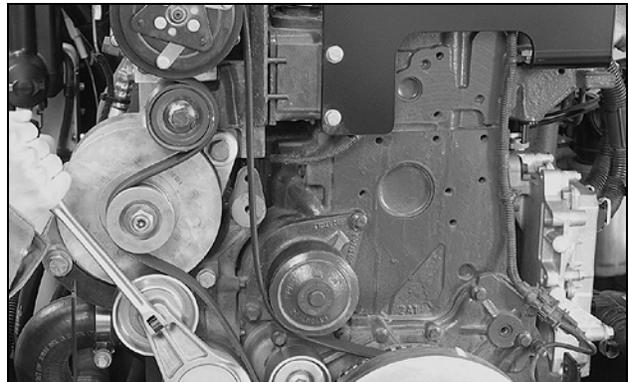


BD06F114

Remove the four mounting bolts from the belt cover, remove the cover.

NOTE: After removing the belt cover remove the cover mounting brackets from the machine frame.

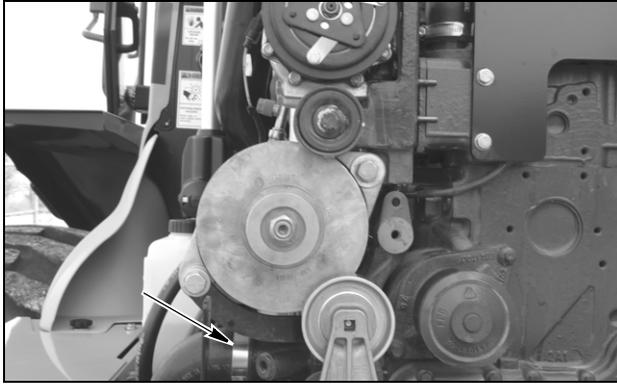
STEP 23



BD06F115

Remove the drive belt from the engine.

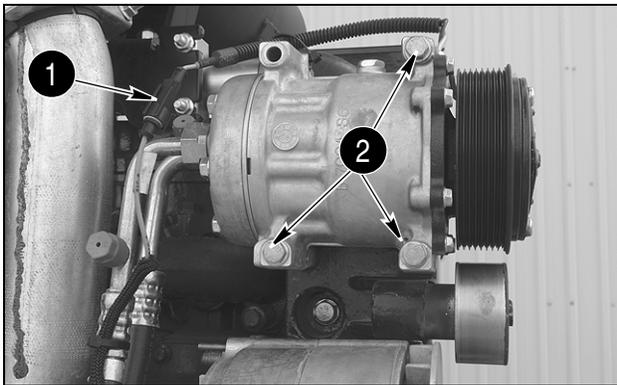
STEP 24



BD06F116

Loosen clamps and remove lower cooler hose from the engine.

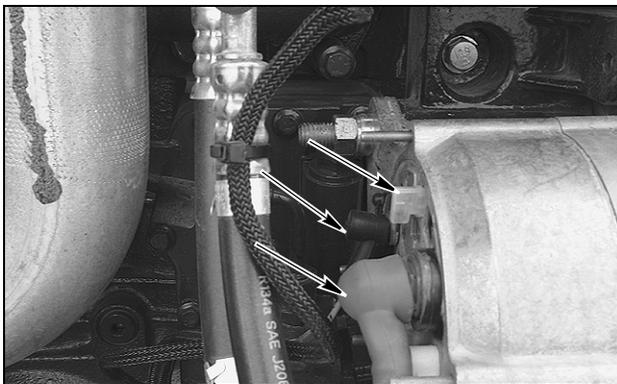
STEP 25



BD06F117

If loader is equipped with air conditioning, identify, tag, and disconnect the engine wiring harness connectors from air compressor clutch connector (1). Remove the three mounting bolts (2) for the compressor and set the compressor on the left battery cover.

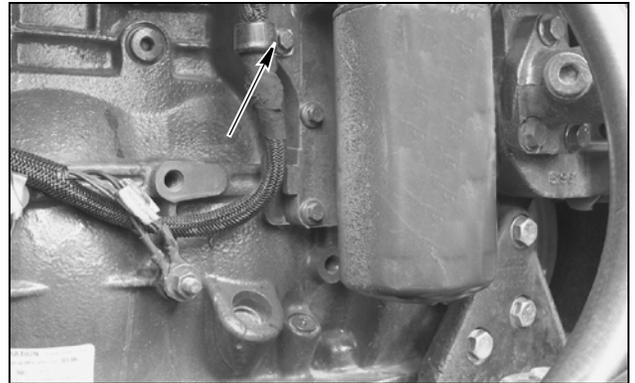
STEP 26



BD06F118

Tag and disconnect the wiring from the alternator.

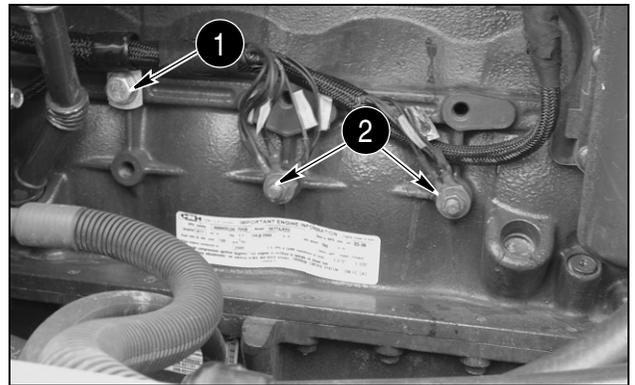
STEP 27



BD06F119

Remove bolt securing wiring harness clamp to engine.

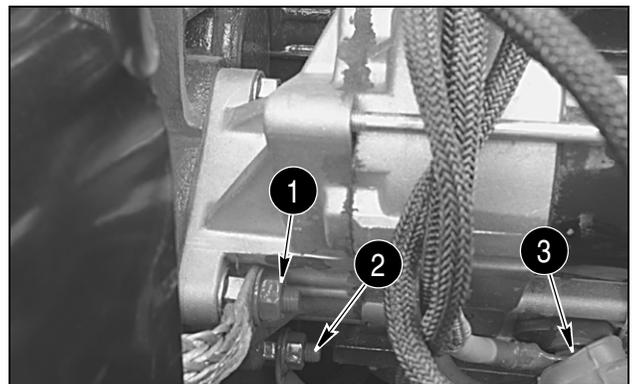
STEP 28



BD06F120

Remove bolt securing wiring harness clamp (1) to the engine. Remove ground wires (2) from the engine.

STEP 29

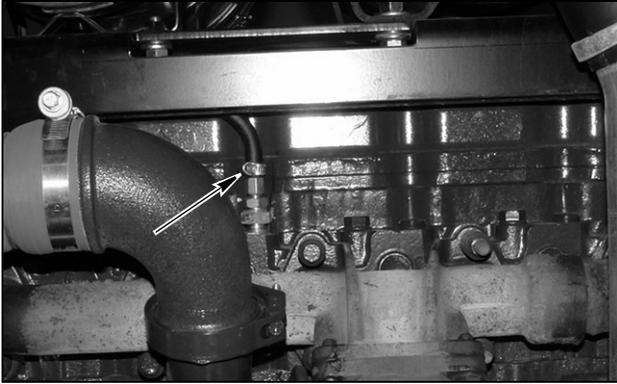


BD06F121

Tag and remove the wires from the starter solenoid (3), remove the ground cable (2), and ground strap (1) from the starter.

NOTE: Move the starter cables away from the engine, move the wiring harness away from the engine.

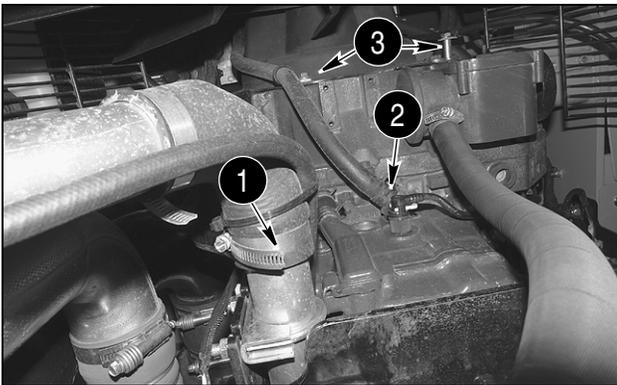
STEP 30



BD06F146

Disconnect the engine coolant vent hose and route to the rear of the engine.

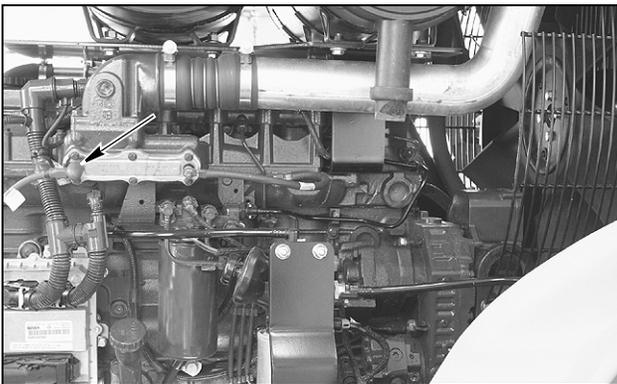
STEP 31



BD06F122

Remove the radiator hose (1) from the rear of the engine, remove the heater hose from the rear of the engine (2), remove the clamp bolts and clamps (3) from the bell housing.

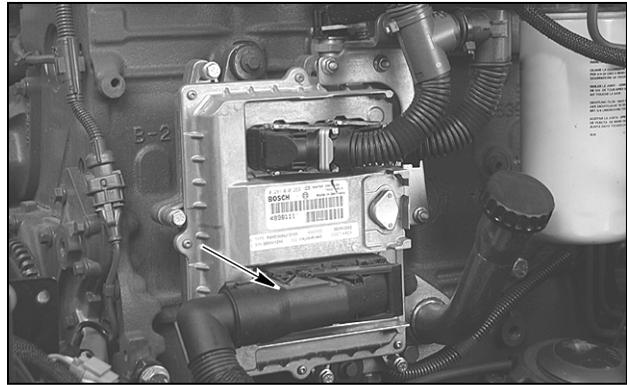
STEP 32



BD06F111

Tag and remove the grid heater cable.

STEP 33

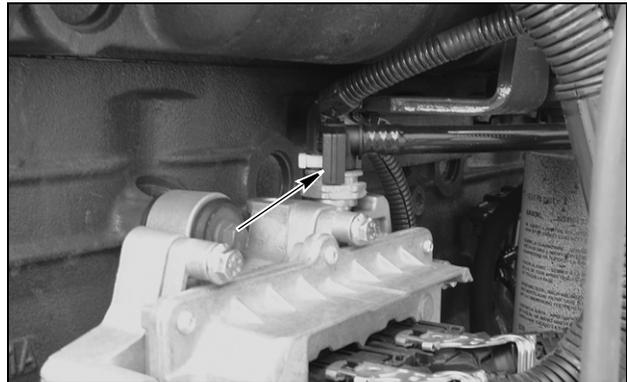


BD03A142

Disconnect the wiring harness from the EDC 7 controller.

NOTE: Lifting up on the lever will release the connector from the controller.

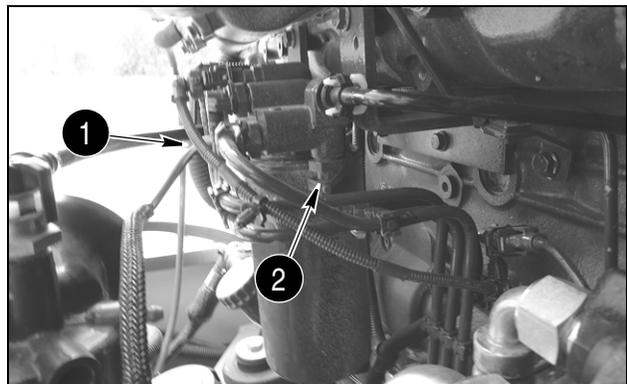
STEP 34



BD06F123

Remove the fuel line from the top of the EDC 7 controller, plug the line and cap the fitting.

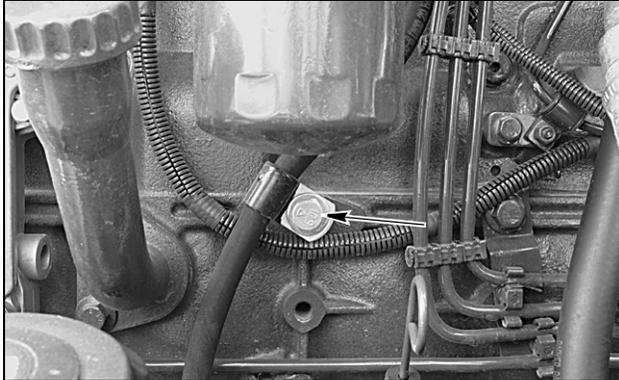
STEP 35



BD06F124

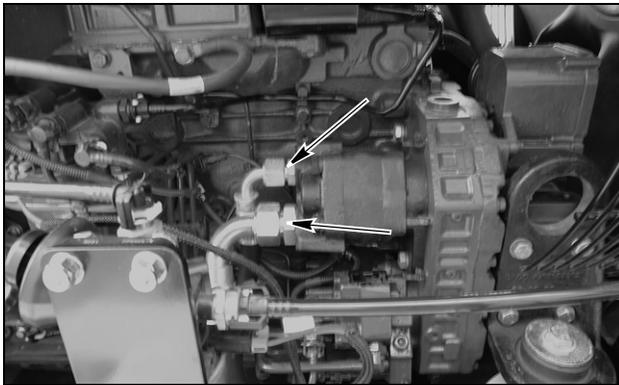
Tag and disconnect the fuel filter heater wires (1), disconnect the fuel line (2) from the fuel filter head, plug the line and cap the fitting.

STEP 36



Remove bolt and clamp.

STEP 37



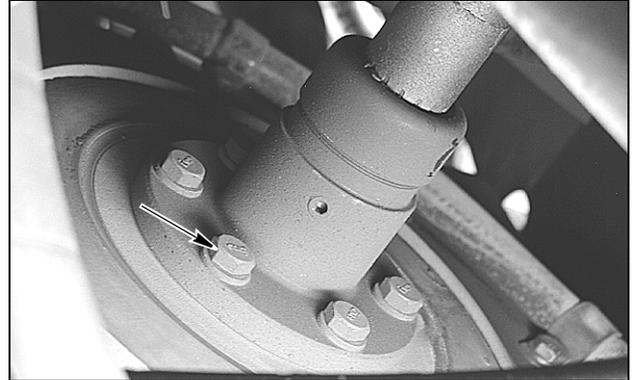
Connect and turn on vacuum pump to hydraulic reservoir. Tag and remove the hydraulic lines from the brake system pump, plug the lines and cap the fittings.

STEP 38



Remove the lower cover for the drive shaft.

STEP 39



Remove the drive shaft bolts from the flywheel. Move the drive shaft clear of the flywheel.

STEP 40

Connect suitable lifting equipment to engine lifting brackets. Take up all slack in lifting equipment. Remove the engine mounting bolts and lift the engine enough to gain access to the drain hose, pull the drain hose with the engine.

STEP 41

Slowly raise engine from rear chassis. Be sure all harness connections and hoses have been disconnected and are clear of the engine. Remove engine from machine.