Specifications

Test and Adjustment Specifications

Fan/Alternator Drive Belt Deflection at 98 N (22 lb-force)	10-15 mm (0.400-0.600 in.)
Valve Stem-to-Rocker Arm Clearance	0.15-0.25 mm (0.006-0.010 in.)
Cylinder Compression	
Models 1600/1620 (Min)	2744 kPa (398 psi)
Model 1600 Turbo (Min)	2447 kPa (355 psi)
Difference between Cylinders (Max)	296 kPa (43 psi)
Engine Oil Pressure at 3200 RPM	344 ± 48 kPa (50 ± 7 psi)
Rotor Shaft Axial Play	
Standard	0.03-0.06 mm (0.0012-0.0024 in.)
Wear Limit	0.09 mm (0.0035 in.)
Rotor Shaft Radial Play	
Standard	0.08-0.13 mm (0.0031-0.0051 in.)
Wear Limit	0.17 mm (0.0067 in.)
Fuel Supply Pump Pressure (Min)	29 kPa (4.3 psi)
Fuel System Leakage Test Pressure	34-69 kPa (5-10 psi)
Fuel System Leakage Test Pressure (Max)	103 kPa (15 psi)
Slow Idle Speed	700 rpm
Throttle Lever Fast Idle Stop Position (Distance from End of Frame Slot)	6 mm (0.25 in.)
Fuel Injection Nozzle Opening Pressure	11 722 ± 480 kPa (1700 ± 70 psi)
Fuel Injection Nozzle Leakage at 11 032 kPa (1600 psi)	No leakage for a minimum of 10 seconds
Slow Hand	
Lever Movement	Chatter sound
Lever Movement	Fine stream spray pattern
Fast Hand	
Lever Movement	Fine atomized spray pattern
Radiator Cap Opening Pressure	90 ± 14 kPa (13 ± 2 psi)
Thermostat Opening Temperature - Beginning	69-72°C (156-162°F)
Thermostat Opening Temperature - Fully Open	85°C (184°F)
Coolant Temperature Switch Operating Temperature	107-113°C (225-235°F)

Repair Specifications

Models 1600/1620 Cooling System Capacity	9.5 L (2.5 gal)
Model 1600 Turbo Cooling System Capacity	7.5 L (8 qt)
Models 1600/1620 Engine Oil Crankcase Capacity (with Filter)	5.8 L (6.1 qt)
Model 1600 Turbo Engine Oil Crankcase Capacity (with Filter)	6.6 L (7 qt)
Oil Filter Block Cap Screw Torque	27 N•m (20 lb-ft)

Oil Cooler Mounting Cap Screw Torque	30 N•m (22 lb-ft)
Rocker Arm Assembly	
Rocker Arm Shaft Outside Diameter (Wear Limit)	15.95 mm (0.628 in.)
Rocker Arm Bearing Inside Diameter (Wear Limit)	16.09 mm (0.633 in.)
Rocker Arm-to-Shaft Clearance (Wear Limit)	0.14 mm (0.006 in.)
Push Rod Bend (Max)	0.03 mm (0.001 in.)
Cylinder Head	
Cylinder Head Mounting Cap Screw Final Torque	88 N•m (65 lb-ft)
Valve Recession (Max)	1.0 mm (0.04 in.)
Cylinder Head Distortion (Max)	0.15 mm (0.006 in.)
Intake Valve Seat Width (Standard)	1.07-1.24 mm (0.042-0.049 in.)
Exhaust Valve Seat Width (Standard)	1.24-1.45 mm (0.049-0.057 in.)
Intake Valve Seat Width (Wear Limit)	1.74 mm (0.068 in.)
Exhaust Valve Seat Width (Wear Limit)	1.94 mm (0.076 in.)
Intake Valve Seat Angle	30°
Exhaust Valve Seat Angle	45°
Intake and Exhaust Valve Seat Angle Narrowing Angle	70°
Valve Guide Inside Diameter (Wear Limit)	8.1 mm (0.32 in.)
Valve Guide-to-Valve Stem Oil Clearance (Max)	0.20 mm (0.008 in.)
Intake and Exhaust Valve Margin (Min)	0.50 mm (0.02 in.)
Intake and Exhaust Valve Stem Outside Diameter (Wear Limit)	7.90 mm (0.311 in.)
Valve Spring Free Length	42 mm (1.653 in.)
Valve Spring Inclination (Max)	1.10 mm (0.04 in.)
Valve Guide Installed Height (above Spring Seating Surface)	15.0 mm (0.590 in.)
Flywheel Cap Screw Torque	86 N•m (63 lb-ft)
Crankshaft Pulley Cap Screw Torque	117 N•m (86 lb-ft)
Oil Pump	
Gear Backlash (Max)	0.12 mm (0.005 in.)
Rotor Shaft-to-Bore Clearance (Max)	0.2 mm (0.008 in.)
Outer Rotor-to-Pump Body Clearance (Max)	0.25 mm (0.020 in.)
Outer Rotor-to-Pump Body Recess (Max)	0.15 mm (0.006 in.)
Inner Rotor-to-Outer Rotor Clearance (Max)	0.15 mm (0.006 in.)
Idler Gear	
Shaft Outside Diameter (Wear Limit)	45.93 mm (1.808 in.)
Bushing Inside Diameter (Wear Limit)	46.08 mm (1.814 in.)
Shaft-to-Bushing Clearance (Max)	0.15 mm (0.006 in.)
Timing Cover Mounting Plate Cap Screw Torque	25 N•m (220 lb-in.)
Connecting Rod Side Play (Max)	0.40 mm (0.016 in.)
Connecting Rod Bearing-to-Crankshaft Clearance (Max)	0.16 mm (0.006 in.)

Piston

Piston Ring-to-Groove Clearance (First Compression Ring)	0.070-0.105 mm (0.003-0.004 in.)
Piston Ring-to-Groove Clearance (Second Compression Ring)	0.035-0.070 mm (0.001-0.004 in.)
Piston Ring-to-Groove Clearance (Oil Ring)	0.025-0.060 mm (0.001-0.002 in.)
Piston Ring End Gap - First Compression Ring (Standard)	0.20-0.40 mm (0.007-0.016 in.)
Piston Ring End Gap - First Compression Ring (Max)	1.50 mm (0.059 in.)
Piston Ring End Gap - Second Compression Ring (Standard)	0.20-0.40 mm (0.007-0.016 in.)
Piston Ring End Gap - Second Compression Ring (Max)	1.50 mm (0.059 in.)
Piston Ring End Gap - Oil Rings (Standard)	0.20-0.40 mm (0.007-0.016 in.)
Piston Ring End Gap - Oil Rings (Max)	1.50 mm (0.059 in.)
Piston Pin Outside Diameter (Wear Limit)	25.90 mm (1.019 in.)
Piston Pin Bore Inside Diameter (Wear Limit)	26.02 mm (1.024 in.)
Piston Pin-to-Piston Bore Clearance (Wear Limit)	0.12 mm (0.015 in.)
Models 1600/1620 Standard Size Piston Outside Diameter (Wear Limit)	87.90 mm (3.461 in.)
Model 1600 Turbo Standard Size Piston Outside Diameter (Wear Limit)	83.90 mm (3.303 in.)
Models 1600/1620 0.25 mm (0.010) Oversize Piston Outside Diameter (Wear Limit)	88.15 mm (3.470 in.)
Model 1600 Turbo 0.25 mm (0.010) Oversize Piston Outside Diameter (Wear Limit)	84.15 mm (3.313 in.)

Connecting Rod

Connecting Rod Cap Screw Torque	49 N•m (36 lb-ft)
Connecting Rod Bearing Inside Diameter (Wear Limit)	51.01 mm (2.008 in.)
Piston Pin Bushing Inside Diameter (Max)	26.10 mm (1.03 in.)
Piston Pin-to-Connecting Rod Clearance (Wear Limit)	0.20 mm (0.007 in.)
Piston Pin-to-Connecting Rod Bore Clearance (Wear Limit)	0.20 mm (0.007 in.)

Crankshaft End Play	0.09-0.27 mm (0.004-0.011 in.)

Main Bearings

Main Bearing Cap Screw Torque	98 N•m (72 lb-ft)
Main Bearing-to-Crankshaft Journal Clearance (Wear Limit)	0.15 mm (0.006 in.)
Main Bearing Thickness (Wear Limit)	1.995 mm (0.08 in.)

Crankshaft

Connecting Rod Journal Outside Diameter (Wear Limit)	47.91 mm (1.88 in.)
Main Bearing Journal Outside Diameter (Wear Limit)	53.91 mm (2.12 in.)
Crankshaft Bend (Max)	0.02 mm (0.001 in.)

Piston Cooling Nozzle Orifice Diameter	1.77 mm (0.069 in.)
Piston Cooling Valve Torque	15 N•m (11 lb-ft)

Cam Follower

Outside Diameter (Wear Limit)	11.93 mm (0.470 in.)
Bore Inside Diameter-Engine Block (Wear Limit)	12.05 mm (0.474 in.)
Cam Follower-to-Bearing Clearance (Wear Limit)	0.12 mm (0.005 in.)

Camshaft

End Play (Standard)	0.05-0.25 mm (0.002-0.010 in.)
End Play (Max)	0.40 mm (0.016 in.)
Timing Gear Backlash (Max) - All (Except Oil Pump Gear)	0.07-0.15 mm (0.003-0.005 in.)
Timing Gear Backlash (Max) - Oil Pump Gear	0.11-0.19 mm (0.004-0.008 in.)
Retainer Cap Screw Torque	11 N•m (96 lb-in.)
Camshaft Bend (Max)	0.02 mm (0.001 in.)
Lobe Height (Wear Limit)	38.40 mm (1.512 in.)
End Journal Outside Diameter (Wear Limit)	44.85 mm (1.766 in.)
Intermediate Journal Outside Diameter (Wear Limit)	44.85 mm (1.766 in.)
Camshaft Journal-to-Timing Gear End Bushing Clearance (Wear Limit)	0.130 mm (0.005 in.)
Camshaft Journal-to-Intermediate Bushing Clearance (Wear Limit)	0.115 mm (0.004 in.)
Camshaft Journal-to-Flywheel End Bushing Clearance (Wear Limit)	0.110 mm (0.004 in.)

Cylinder Block (Models 1600/1620)

Standard Bore Inside Diameter	88.00-88.03 mm (3.464-3.465 in.)
Standard Bore Inside Diameter (Wear Limit)	88.20 mm (3.472 in.)
0.25 mm (0.010 in.) Oversize Bore Inside Diameter	88.25-88.28 mm (3.474-3.475 in.)
0.25 mm (0.010 in.) Oversize Bore Inside Diameter (Wear Limit)	88.45 mm (3.482 in.)

Cylinder Block (Model 1600 Turbo)

Standard Bore Inside Diameter	84.00-84.03 mm (3.307-3.308 in.)
Standard Bore Inside Diameter (Wear Limit)	84.20 mm (3.315 in.)
0.25 mm (0.010 in.) Oversize Bore Inside Diameter	84.25-84.28 mm (3.317-3.318 in.)
0.25 mm (0.010 in.) Oversize Bore Inside Diameter (Wear Limit)	84.45 mm (3.325 in.)

Starting Motor

Brush Length (Min)	8.50 mm (0.335 in.)

Alternator

Pulley Retaining Nut Torque	69 N•m (51 lb-ft)
Rotor Slip Ring Outside Diameter (Wear Limit)	14 mm (0.55 in.)
Brush Exposed Length (Max)	10.5 mm (0.41 in.)
Brush Length (Min)	4.5 mm (0.17 in.)

Fuel Tank Capacity (Models 1600/1620)	57 L (15 gal)
Fuel Tank Capacity (Model 1600 Turbo)	87 L (22 gal)
Fuel Injector Line Nut Torque	32 N•m (24 lb-ft)
Fuel Injector Clamp Nut Torque	5 N•m (44 lb-ft)
Fuel Injector Retaining Nut Torque	8 N•m (72 lb-in.)
Fuel Injector Separator Plate Contact Surface	0.10 mm (0.004 in.)

Diagnostics

Engine Exterior

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in OFF position.

(1) Exterior Engine Surface
Are leaks evident on external surface of engine?
Yes - Check gaskets, seals, plugs, cylinder head, block, and intake manifold and breather. Repair as needed.
No - Go To (2) Muffler on page 31

(2) Muffler
Is muffler free of obstructions?
Is muffler in good condition without holes or dents?
No - Replace muffler.

Engine Oil/Lubrication System

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in OFF position.

(1) Engine Oil Dipstick
Check engine oil level and observe the condition of the oil.
Is oil level between the ADD and FULL marks?
Is oil in good condition, not burnt, and free of metal particles, fuel, and coolant?
Yes - Go To (2) Oil Pressure Sender Port on page 31
No - Add/drain oil to bring level to the FULL mark.

(2) Oil Pressure Sender Port
Test Conditions:
• Engine running at SLOW idle.
Is oil pressure to specification?
No - Repair oil pump or pressure regulating valve as needed.

Specifications

Engine Oil Pressure at 3200 RPM 344 ± 48 kPa (50 ± 7 psi)

Air Intake System

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Engine running at FAST idle.

(1) Air Filter Restriction Indicator
Does the plunger in the gauge indicate the filter needs servicing?
Yes - Service air cleaner filter elements.
No - Go To (2) Air Cleaner Housing on page 31

(2) Air Cleaner Housing
Is housing in good condition, sealed, and undamaged?
Yes - Go To (3) Air Cleaner Hoses on page 31
No - Replace air cleaner housing assembly.

(3) Air Cleaner Hoses
Are clamps tight?
Are hoses in good condition, free of cracks and holes?
No - Clamps are not tight. Tighten clamps.
No - Hoses are in poor condition or have cracks or holes. Replace hoses.

Cooling System

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in OFF position unless indicated otherwise.

(1) Recovery Tank and Radiator
Is coolant between marks on tank when engine is warm and is coolant in radiator full to top of filler neck?
Is coolant free of contamination, no oil, no fuel, and not discolored brown?
Are radiator fins free of debris?
Is radiator free of damage and free of leaks?
Is the radiator cap tight?
Yes - Go To (2) Radiator Hoses on page 32
No - Coolant is not between the marks. Add proper coolant mix.
No - Coolant is contaminated. Drain and flush cooling system. Check for source of contamination. Refill cooling system with correct coolant.
No - Radiator fins have debris. Clean or replace radiator.
No - Radiator is damaged and/or leaks. Repair or replace radiator.
No - Radiator cap is not tight. Pressure test radiator cap.

(2) Radiator Hoses
Are hoses cracked or leaking?
Are hose clamps loose?
Yes - Pressure test cooling system.
No - Go To (3) Fan/Alternator Drive Belt on page 32

(3) Fan/Alternator Drive Belt
Is belt properly tensioned?
Is belt in good condition, not glazed nor cracked?
Yes - Go To (4) Fan Blade on page 32
No - Belt is not properly tensioned. Adjust belt tension.
No - Belt is glazed or cracked. Replace belt.

(4) Fan Blade
Are fan blades damaged or warped?
Yes - Replace fan.
No - Go To (5) Thermostat on page 32

(5) Thermostat
Is the thermostat free of corrosion, rust, and debris?
Test opening temperature of thermostat. Is the opening temperature within specifications?
No - Thermostat has corrosion, rust, or debris. Replace thermostat.
No - Opening temperature is not within specifications. Replace thermostat.

Specifications

Thermostat Opening Temperature - Beginning . . 69-72° C (156-162° F)

Thermostat Opening Temperature - Fully Open. . 85° C (185° F)

Fuel System

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in OFF position unless indicated otherwise.

(1) Fuel Tank
Is fuel level correct with proper grade of fuel, not contaminated, and contains no water?
Yes - Go To (2) Fuel Filter on page 32
No - Drain and clean fuel tanks. Add fresh fuel.

(2) Fuel Filter
Is filter element free of debris.
Yes - Go To (3) Fuel Filter Shutoff Valve on page 32
No - Replace filter element.

(3) Fuel Filter Shutoff Valve
Is shutoff valve in ON position?
Yes - Go To (4) Fuel Line and Clamps on page 33
No - Move valve to ON position.