

VOLVO PENTA

TWD 1643GE

Document No

21117581

Issue Index

01**General**

In-line four stroke diesel engine with direct injection. Rotation direction, anti-clockwise viewed towards flywheel.

Turbocharged

| | | | |
|---------------------|---------------------------------------|----|-------------|
| Number of cylinders | | | 6 |
| Displacement, total | litre | | 16,12 |
| | in ³ | | 983,9 |
| Firing order | | | 1-5-3-6-2-4 |
| Bore | mm | | 144 |
| | in | | 5,67 |
| Stroke | mm | | 165 |
| | in | | 6,50 |
| Compression ratio | | | 16,5:1 |
| Dry weight | Engine only, excluding cooling system | kg | 1700 |
| | | lb | 3748 |
| | GenPac | kg | 2200 |
| | | lb | 4850 |
| Wet weight | Engine only, excluding cooling system | kg | 1770 |
| | | lb | 3902 |
| | GenPac | kg | 2370 |
| | | lb | 5225 |

Performance

| | | r/min | 1500 | 1800 |
|--|-------------------|---------------|-------|------|
| Prime Power | without fan | kW | 553 | 615 |
| | | hp | 752 | 836 |
| | with fan | kW | 536 | 585 |
| | | hp | 729 | 796 |
| Standby Power | without fan | kW | 613 | 674 |
| | | hp | 834 | 917 |
| | with fan | kW | 596 | 644 |
| | | hp | 811 | 876 |
| | without fan | kW | | |
| | | hp | | |
| | with fan | kW | | |
| | | hp | | |
| Torque at: | Prime Power | Nm | 3521 | 3263 |
| | | lbft | 2596 | 2406 |
| | Standby Power | Nm | 3902 | 3576 |
| | | lbft | 2878 | 2637 |
| Mean piston speed | m/s | 8,3 | 9,9 | |
| | ft/sec | 27,1 | 32,6 | |
| Effective mean pressure at: | Prime Power | MPa | 2,7 | 2,5 |
| | | psi | 398 | 369 |
| Effective mean pressure at: | Standby Power | MPa | 3,0 | 2,8 |
| | | psi | 441 | 404 |
| Max combustion pressure at: | Prime Power | MPa | 18,8 | 19,6 |
| | | psi | 2727 | 2843 |
| Max combustion pressure at: | Standby Power | MPa | 20 | 19,8 |
| | | psi | 2901 | 2872 |
| Total mass moment of inertia, J (mR ²) | kgm ² | | 4,20 | |
| | lbft ² | | 99,7 | |
| Degree of irregularity at: | Prime Power | | 1:33 | 1:55 |
| | | Standby Power | | 1:29 |
| Friction Power | kW | | 38 | 55 |
| | hp | | 51,68 | 74,8 |

Derating

The engine may be operated up to 1500m without derating.

For operating at higher altitudes the power will be derated according to the graph below.

There is no derating for ambient temperature or humidity.

Engine noise emission

Test Standards: ISO 3744-1981 (E) sound power (without fan, intake and exhaust noise)

Tolerance ± 0.75 dB(A)

| | | r/min | 1500 | 1800 |
|-------------------------------------|---------------|-------|------|------|
| Measured sound power Lw | No load | dB(A) | 113 | 117 |
| | Prime Power | dB(A) | 117 | 120 |
| | Standby Power | dB(A) | 117 | 120 |
| Calculated sound pressure Lp at 1 m | No load | dB(A) | 101 | 105 |
| | Prime Power | dB(A) | 105 | 108 |
| | Standby Power | dB(A) | 105 | 108 |

Unsilenced exhaust noise

Data calculated as sound pressure Lp.

Assumed microphone distance 1 m

| | r/min | 1500 | 1800 |
|---------------|-------|------|------|
| Prime Power | dB(A) | 116 | 120 |
| Standby Power | dB(A) | 117 | 120 |

Test conditions for load acceptance data

| | | | |
|--------------|------------------|--------------|--------------------|
| Warm engine. | Generator | Model | Type of AVR |
| | Stamford | HCI534F1 | MX341 |

Load acceptance performance can vary due to actual alternator inertia, voltage regulator, type of load and local ambient conditions.

Single step load performance at 1500 rpm

| Load (%) | Speed diff (%) | | Recovery time (s) | | Remaining load (%) | Speed diff (%) | | Recovery time (s) | |
|----------|----------------|---------|-------------------|---------|--------------------|----------------|---------|-------------------|---------|
| | Prime | Standby | Prime | Standby | | Prime | Standby | Prime | Standby |
| 0-20 | 2,8 | | 1,8 | | 20-100 | 11,6 | | 3,7 | |
| 0-40 | 5,6 | | 1,9 | | 40-100 | 7,3 | | 2,7 | |
| 0-48 | 7,0 | | 2,6 | | 48-100 | 6,3 | | 2,1 | |
| 0-60 | 8,8 | | 2,8 | | 60-100 | 5,5 | | 1,9 | |
| 0-65 | 10,0 | | 3,1 | | 65-100 | 4,6 | | 1,5 | |
| 0-80 | 13,6 | | 4,0 | | 80-100 | 3,1 | | 1,5 | |
| 0-100 | 18,7 | | 5,5 | | | | | | |
| 100-0 | 8,8 | | 2,4 | | | | | | |
| 0-20 | | 3,2 | | 1,9 | 20-98 | | 12,5 | | 9,2 |
| 0-40 | | 6,3 | | 2,1 | 40-98 | | 7,5 | | 9,0 |
| 0-44 | | 7,0 | | 2,7 | 44-98 | | 7,0 | | 7,8 |
| 0-59 | | 10,0 | | 3,3 | 59-98 | | 5,8 | | 4,3 |
| 0-60 | | 10,2 | | 3,4 | 60-98 | | 5,7 | | 3,9 |
| 0-80 | | 15,9 | | 4,5 | 80-98 | | 3,0 | | 1,6 |
| 0-98 | | 20,4 | | 8,8 | | | | | |
| 98-0 | | 9,1 | | 2,4 | | | | | |

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Single step load performance at 1800 rpm

| Load (%) | Speed diff % | | Recovery time (s) | | Remaining load (%) | Speed diff (%) | | Recovery time (s) | |
|----------|--------------|---------|-------------------|---------|--------------------|----------------|---------|-------------------|---------|
| | Prime | Standby | Prime | Standby | | Prime | Standby | Prime | Standby |
| 0-20 | 1,6 | | 1,4 | | 20-100 | 7,3 | | 2,2 | |
| 0-40 | 3,6 | | 1,5 | | 40-100 | 4,8 | | 2,0 | |
| 0-60 | 5,5 | | 1,7 | | 60-100 | 3,7 | | 1,6 | |
| 0-69 | 7,0 | | 1,8 | | 69-100 | 2,9 | | 1,3 | |
| 0-80 | 8,6 | | 2,0 | | 80-100 | 1,8 | | 1,3 | |
| 0-86 | 10,0 | | 2,0 | | 86-100 | 1,2 | | 1,2 | |
| 0-100 | 11,9 | | 2,0 | | | | | | |
| 100-0 | 5,8 | | 2,6 | | | | | | |
| 0-20 | | 1,8 | | 1,5 | 20-99 | | 7,7 | | 14,8 |
| 0-40 | | 4,0 | | 1,7 | 40-99 | | 5,5 | | 11,2 |
| 0-60 | | 6,2 | | 1,8 | 60-99 | | 3,8 | | 4,4 |
| 0-64 | | 7,0 | | 1,8 | 64-99 | | 3,6 | | 4,3 |
| 0-79 | | 10,0 | | 1,9 | 79-99 | | 1,8 | | 1,4 |
| 0-80 | | 10,2 | | 1,9 | 80-99 | | 1,7 | | 1,3 |
| 0-99 | | 13,5 | | 8,1 | | | | | |
| 99-0 | | 6,6 | | 2,6 | | | | | |

Cold start performance

| | | r/min | 1500 | 1800 | |
|--|----|-------|------|------|-----|
| Time from start to no load speed at ambient temperature: | °C | 20 | s | 4,2 | 6,0 |
| | | 5 | s | 6,8 | 7,7 |
| | | -15* | s | 4,8 | 5,7 |
| Time from start to stay within 0.5% of no load speed at ambient temperature: | °C | 20 | s | | |
| | | 5 | s | | |
| | | -15* | s | | |

* With manifold heater 4 kW engaged, lubrication oil 15W/40 and block heater.

| Block heater type | Make | Power kW | Engaged hours | Cooling water temp engine block |
|-------------------|-----------------------|----------|---------------|---------------------------------|
| | Volvo Penta no:889858 | 2000W | 10h | 16°C 61°F |

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| Lubrication system | | r/min | 1500 | 1800 |
|--|----------------------------------|---------------------|----------------------|---------------|
| Lubricating oil consumption | Prime Power | litre/h US gal/h | 0,10 0,026 | 0,10 0,026 |
| | Standby Power | litre/h US gal/h | 0,11 0,029 | 0,11 0,029 |
| Oil system capacity including filters | | litre US gal | 48 12,7 | |
| Oil sump capacity: | max | litre US gal | 42 11,1 | |
| | min | litre US gal | 32 8,5 | |
| Oil change intervals/specifications: | VDS-2/VDS-3* | h | 600 | |
| | VDS, ACEA, E3* | h | 400 | |
| | ACEA E2, API CD, CF, CF-4, CG-4* | h | 200 | |
| Engine angularity limits: | front up | ° | 30 | |
| | front down | ° | 30 | |
| | side tilt | ° | 30 | |
| Oil pressure at rated speed | | kPa psi | 300 - 650 44 - 94 | |
| Oil pressure shut down switch setting | | kPa psi | | |
| Lubrication oil temperature in oil sump: | max | °C | 130 | |
| | | °F | 266 | |
| Oil filter micron size | | μ | 0,040 | |

* See also general section in the sales guide

| Fuel system | | r/min | 1500 | 1800 |
|---|---|-----------------|-----------------|--------------|
| Prime Power Specific fuel consumption at: | 25% | g/kWh lb/hph | 215 0,349 | 224 0,363 |
| | 50% | g/kWh lb/hph | 196 0,318 | 201 0,326 |
| | 75% | g/kWh lb/hph | 196 0,318 | 197 0,319 |
| | 100% | g/kWh lb/hph | 199 0,323 | 202 0,327 |
| | Standby Power Specific fuel consumption at: | 25% | g/kWh lb/hph | 210 0,340 |
| | 50% | g/kWh lb/hph | 195 0,316 | 200 0,324 |
| | 75% | g/kWh lb/hph | 196 0,318 | 198 0,321 |
| | 100% | g/kWh lb/hph | 200 0,324 | 204 0,331 |

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| Fuel system | r/min 1500 1800 | | |
|---|--|---------------|---------------|
| Fuel to conform to | ASTM-D975-No1 and 2-D JIS KK 2204, EN 590 | | |
| System supply flow at: | litre/h US gal/h | 190,0 50,2 | 210,0 55,5 |
| Fuel supply line max restriction | kPa psi | 10,0 1,5 | 10,0 1,5 |
| Fuel supply line max pressure, engine stopped | kPa psi | 0,0 0,0 | 0,0 0,0 |
| System return flow | litre/h US gal/h | 25,0 6,6 | 25,0 6,6 |
| Fuel return line max restriction | kPa psi | 20,0 2,9 | 20,0 2,9 |
| Maximum allowable inlet fuel temp | °C °F | 60 140 | 60 140 |
| Prefilter / Water separator micron size | μ | 0,010 | |
| Fuel filter micron size | μ | | |
| Governor type/make, standard | Volvo / EMS 2 | | |
| Injection pump type/make | Delphi / E3 | | |
| Injection timing std. | °B.T.D.C | | |
| Injection timing | °B.T.D.C | | |

| Intake and exhaust system | | r/min 1500 1800 | | |
|---|---------------|------------------------------|---------------|---------------|
| Air consumption at: (+25°C and 100kPa) | Prime Power | m ³ /min cfm | 43,65 1541 | 53,07 1874 |
| | Standby Power | m ³ /min cfm | 46,96 1658 | 54,85 1937 |
| Max allowable air intake restriction including piping | | kPa psi | 5 0,7 | 5 0,7 |
| Air filter type | | Single stage paper cartridge | | |
| Air filter cleaning efficiency | | % | 99,85 | |
| Heat rejection to exhaust at: | Prime Power | kW BTU/min | 415 23601 | 472 26842 |
| | Standby Power | kW BTU/min | 463 26330 | 530 30141 |
| Exhaust gas temperature after Low Pressure turbine at: | Prime Power | °C °F | 450 842 | 422 792 |
| | Standby Power | °C °F | 463 865 | 461 862 |
| Max allowable back pressure in exhaust line | | kPa psi | 10 1,5 | 10 1,5 |
| Exhaust gas flow at: (temp and pressure after turbine at the corresponding power setting) | Prime Power | m ³ /min cfm | 101,6 3588 | 119,0 4202 |
| | Standby Power | m ³ /min cfm | 111,8 3948 | 130,1 4594 |

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| Cooling system | | r/min | 1500 | 1800 |
|--|--|---------------|-------------|-------------|
| Heat rejection radiation from engine at: | Prime Power | kW | 23 | 26 |
| | | BTU/min | 1308 | 1479 |
| | Standby Power | kW | 33 | 33 |
| | | BTU/min | 1877 | 1877 |
| Heat rejection to coolant engine radiator at: | Prime Power | kW | 208 | 246 |
| | | BTU/min | 11829 | 13990 |
| | Standby Power | kW | 226 | 270 |
| | | BTU/min | 12852 | 15355 |
| Heat rejection to coolant CAC radiator at: | Prime Power | kW | 116 | 121 |
| | | BTU/min | 6597 | 6881 |
| | Standby Power | kW | 125 | 135 |
| | | BTU/min | 7109 | 7677 |
| Coolant | Volvo Penta coolant "ready mix" or Volvo Penta coolant mixed with clean fresh water 40 / 60. | | | |
| Radiator cooling system type | Closed circuit | | | |
| Engine radiator core area | m ² | 1,68 | | |
| | foot ² | 18,08 | | |
| CAC radiator core area | m ² | 1,68 | | |
| | foot ² | 18,08 | | |
| Fan diameter | mm | 965 | | |
| | in | 37,99 | | |
| Fan power consumption | kW | 17 | 30 | |
| | hp | 23 | 41 | |
| Fan drive ratio | 1,04:1 | | | |
| Coolant capacity, | engine | litre | 33 | |
| | | US gal | 8,72 | |
| | Engine radiator and CAC radiators with hoses | litre | 95 | |
| | | US gal | 25,10 | |
| Coolant pump | drive/ratio | Belt / 1,85:1 | | |
| Coolant flow engine radiator (at fully open thermostat) | l/s | 4,8 | 6,0 | |
| | US gal/s | 1,27 | 1,59 | |
| Coolant flow CAC radiator (at fully open thermostat) | l/s | 1,5 | 1,6 | |
| | US gal/s | 0,40 | 0,42 | |
| Coolant pressure drop over engine-radiator incl. piping | kPa | 34 | 50 | |
| | psi | 4,9 | 7,3 | |
| Coolant pressure drop over CAC-radiator incl. piping | kPa | 24 | 25 | |
| | psi | 3,5 | 3,6 | |
| Coolant pressure drop over complete cooling system | kPa | 87 | 105 | |
| | psi | 12,6 | 15,2 | |
| Thermostat | start to open | °C | 82 | |
| | | °F | 180 | |
| | fully open | °C | 92 | |
| | | °F | 198 | |
| Maximum static pressure head (expansion tank height + pressure cap setting) | kPa | 100 | | |
| | psi | 14,5 | | |
| Minimum static pressure head (expansion tank height + pressure cap setting) | kPa | 70 | | |
| | psi | 10,2 | | |
| Standard pressure cap setting | kPa | 75 | | |
| | psi | 10,9 | | |
| Maximum top tank temperature | °C | 103 | | |
| | °F | 217 | | |
| Draw down capacity | 4% of total cooling system capacity | | | |

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| Charge air cooler system | | r/min | 1500 | 1800 |
|--|---------------|-------------------|-------------|-------------|
| Heat rejection to charge air coolers | Prime Power | kW | 125 | 156 |
| | | BTU/min | 7109 | 8872 |
| | Standby Power | kW | 142 | 180 |
| BTU/min | | 8075 | 10236 | |
| Charge air mass flow | Prime Power | kg/s | 0,86 | 10,5 |
| | | kg/s | 0,93 | 10,9 |
| | kg/s | | | |
| Charge air inlet temp. (Charge air temp after turbo compressor) | Prime Power | °C | | |
| | | °F | | |
| | Standby Power | °C | | |
| °F | | | | |
| Charge air temperature. Inlet manifold, max allowed. (At air inlet temp. 25 degr. C) | Prime Power | °C | | |
| | | °F | | |
| | Standby Power | °C | 50 | 50 |
| °F | | 122 | 122 | |
| Maximum pressure drop over charge air cooler incl. piping | | °C | | |
| | | °F | | |
| Charge air pressure (After charge air coolers) | | kPa | 462 | 462 |
| | | psi | 67,01 | 67,01 |
| Standard charge air cooler core area | | m ² | | |
| | | foot ² | | |

Cooling performance

Cooling air flow and external restriction at different radiator air temperatures based on 103°C TTT and 50% antifreeze (radiator and cooling fan, see optional equipment)

| Engine speed rpm | Air on temp °C | PRIME POWER | | STANDBY POWER | |
|---------------------|----------------------|------------------|----------------------------|------------------|----------------------------|
| | | Air flow kg/s | External restriction Pa | Air flow kg/s | External restriction Pa |
| 1500 | 33 | | | 8,0 | 1000 |
| | 39 | 8,0 | 1000 | | |
| | 43 | | | 10,0 | 600 |
| | 49 | 10,0 | 600 | | |
| | 50 | | | 12,0 | 200 |
| | 54 | | | 13,0 | 0 |
| 1800 | 55 | 12,0 | 200 | | |
| | 58 | 13,0 | 0 | | |
| | 35 | | | 10,0 | 1000 |
| | 42 | 10,0 | 1000 | | |
| | 44 | | | 12,0 | 600 |
| | 50 | | | 14,0 | 200 |
| | 51 | 12,0 | 600 | | |
| | 55 | | | 15,0 | 0 |
| | 56 | 14,0 | 100 | | |
| | 58 | 15,0 | 0 | | |

Note! Calculated values >0 Pa

Engine management system

| Functionality | Alternatives | Default setting |
|-----------------------|----------------------------------|-----------------------|
| Governor mode | Isochronous / droop | Isochronous |
| Governor droop | 0-8% | 4% |
| Governor response | Adjustable PID-constants (VODIA) | Not adjusted |
| Dual speed | 1500 / 1800 | According to customer |
| Idle speed | 600-1200 | 900 |
| Fine speed adjustment | ±120 | 0,0 |
| Stop function | Energized to Run / Stop | Energized to Stop |
| Preheating function | On / Off | Off |
| Lamp test | On / Off | On |
| | | |
| | | |

| Engine protection | | Alarm level | | Engine protection | | |
|-----------------------------------|-----------|---------------------------|---------------------|--------------------|--|--------------------|
| Parameter | Unit | Setting range | Default setting | Level | Action. Default/Alternative | |
| Oil temp | °C | 120 - 130 | 125 | Setting +5 | Shut down. ON/OFF* | |
| Oil pressure | Low idle | kPa | - | 190 | 160 | Shut down. ON/OFF* |
| | 1500 rpm | kPa | - | 250 | 220 | Shut down. ON/OFF* |
| | 1800 rpm | kPa | - | 300 | 270 | Shut down. ON/OFF* |
| Oil level | | - | Min level | - | | |
| Piston cooling pressure >1000 rpm | kPa | - | 150 | 150 | Shut down. ON/OFF* | |
| Coolant temp | °C | 95 - 103 | 98 | Setting +5 | Shut down. ON/OFF* | |
| Coolant level | | See cooling system | On | Low level | Shut down. ON/OFF* | |
| Fuel feed pressure | Low idle | kPa | 150 | | - | |
| | >1400 rpm | | 250 | | - | |
| Water in fuel | | - | High level | - | - | |
| Crank case pressure | kPa | - | Increased pressure | Increased pressure | Shut down. ON/OFF* | |
| Air filter pressure droop | kPa | - | 5,0 | - | - | |
| Engine protection | | Alarm level | | Engine protection | | |
| Altitude, above sea | m | - | - | 1500 | Automatic derating, see section derating | |
| Charge air temp | °C | - | 80 | 85 | Shut down. ON/OFF* | |
| Charge air pressure | kPa | - | 500 (absolute) | 510 (absolute) | Shut down. ON/OFF* | |
| Engine speed | rpm | 100 - 120% of rated speed | 115% of rated speed | Alarm level | Shut down. ON/OFF* | |
| Exhaust temp** | °C | - | 610 | 640 | Shut down. ON/OFF* | |
| Low voltage | V | - | 25,5 | - | - | |

* Off means no shut down, alarm only

** Between high pressure turbin and low pressure turbin

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| Electrical system | | r/min | 1500 | 1800 |
|-------------------------------------|---------------|----------------------------|-------------|-------------|
| Voltage and type | | 24V / insulated from earth | | |
| Alternator: | make/output | Amp | Bosch / 80 | |
| | tacho output | Hz/alt. Rev | 6 | |
| | drive ratio | | 3,9 : 1 | |
| Starter motor | make | Melco | | |
| | type | 105P70 | | |
| | kW | 7,0 | | |
| Starter motor solenoid: | pull current | Amp | - | |
| | hold current | Amp | 2,3 | |
| Number of teeth on: | flywheel | 153 | | |
| | starter motor | 12 | | |
| Max wiring resistance main circuit | | mΩ | - | |
| Inrush current at +20°C | | Amp | 750 | |
| Cranking current at +20°C | | Amp | 300 | |
| Crank engine speed at 20°C | | rpm | 155 | |
| Starter motor battery capacity: | max | Ah/A | 2x225 | |
| | min at +5°C | Ah/A | - | |
| Inlet manifold heater (at 20 V) | | kW | 4,0 | |
| Power relay for the manifold heater | | Amp | 1 | |

| Power take off | | r/min | 1500 | 1800 |
|--|-----------|------------------------|----------------|-------------|
| Front end in line with crank shaft max: | | Nm lbft | - | |
| Front end belt pulley load. Direction of load viewed from flywheel side: | max left | kW hp | - | - |
| | max down | kW hp | - | - |
| | max right | kW hp | - | - |
| Timing gear at compressor PTO max: | | Nm lbft | 160 118 | |
| Speed ratio direction of rotation viewed from flywheel side | | 1,31:1/ anti-clockwise | | |
| Timing gear at servo pump PTO max: | | Nm lbft | 100 74 | |
| Speed ratio direction of rotation viewed from flywheel side | | | | |
| Timing gear at hydraulic pump PTO max: | | Nm lbft | - | |
| Speed ratio direction of rotation viewed from flywheel side | | | | |
| Max allowed bending moment in flywheel housing | | Nm lbft | 15000 11063 | |
| Max. rear main bearing load | | N lbf | NA | |