

VOLVO PENTA GENSET ENGINE

TWD1643GE

613 kW (834 hp) at 1500 rpm, 674 kW (917 hp) at 1800 rpm, acc. to ISO 3046

The TWD1643GE is a powerful, reliable and economical Generating Set Diesel Engine built on the dependable in-line six design.

Durability & low noise

Designed for easiest, fastest and most economical installation. Well-balanced to produce smooth and vibration-free operation with low noise level.

To maintain a controlled working temperature in cylinders and combustion chambers, the engine is equipped with piston cooling. The engine is also fitted with replaceable cylinder liners and valve seats/guides to ensure maximum durability and service life of the engine.

Low exhaust emission

The state of the art, high-tech injection and charging system with low internal losses contributes to excellent combustion and low fuel consumption.

The TWD1643GE is certified for EPA Tier 2. An additional feature is that TWD1643GE fulfils EU Stage 2 exhaust emission levels.

Easy service & maintenance

Easily accessible service and maintenance points contribute to the ease of service of the engine.

Technical description

Engine and block

- Optimized cast iron cylinder block with optimum distribution of forces without the block being unnecessarily heavy.
- Wet, replaceable cylinder liners
- Piston cooling for low piston temperature and reduced ring temperature
- Tapered connecting rods for reduce risk of piston cracking
- Crankshaft induction hardened bearing surfaces and fillets with seven bearings for moderate load on main and high-end bearings
- Case hardened and Nitrocarburized transmission gears for heavy duty operation
- Keystone top compression rings for long service life
- Viscous type crankshaft vibration dampers to withstand single bearing alternator torsional vibrations
- Replaceable valve guides and valve seats
- Over head camshaft and four valves per cylinder

Lubrication system

- Full flow oil cooler
- Full flow disposable spin-on oil filter, for extra high filtration
- The lubricating oil level can be measured during operation

- Gear type lubricating oil pump, gear driven by the transmission

Fuel system

- Non-return fuel valve
- Electronic unit injectors
- Fuel prefilter with water separator and water-in-fuel indicator / alarm
- Gear driven low-pressure fuel pump
- Fine fuel filter with manual feed pump and fuel pressure switch
- Fuel shut-off valve

Cooling system

- TWD-cooling system with optimized priority and cold start valves
- Two water cooled charge air coolers
- Efficient cooling with accurate coolant control through a water distribution duct in the cylinder block. Reliable sleeve thermostat with minimum pressure drop
- Belt driven, maintenance-free coolant pump with high degree of efficiency

Turbo charger

- Efficient and reliable dual stage turbo chargers

- Intermediate charge air coolers for both turbo chargers
- Waste gate system for the high pressure turbo charger

Electrical system

- Engine Management System 2 (EMS 2), an electronically controlled processing system which optimizes engine performance. It also includes advanced facilities for diagnostics and fault tracing
- The instruments and controls connect to the engine via the CAN SAE J1939 interface, either through the Control Interface Unit (CIU) or the Display Control Unit (DCU). The CIU converts the digital CAN bus signal to an analog signal, making it possible to connect a variety of instruments. The DCU is a control panel with display, engine control, monitoring, alarm, parameter setting and diagnostic functions. The DCU also presents error codes in clear text.
- Sensors for oil pressure, oil temp, boost pressure, boost temp, exhaust temp, coolant temp, fuel temp, water in fuel, fuel pressure and two speed sensors.



Features

- Cooling system (55°C)
- Fully electronic with Volvo Penta EMS 2
- Dual frequency switch (between 1500 rpm and 1800 rpm)
- High power density
- Emission compliant
- Low noise levels
- Low fuel consumption
- Gen Pac configuration
- Compact design for the power class

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TWD1643GE

Technical Data

General

Engine designation	TWD1643GE	
No. of cylinders and configuration.....	in-line 6	
Method of operation	4-stroke	
Bore, mm (in.).....	144 (5.67)	
Stroke, mm (in.).....	165 (6.50)	
Displacement, l (in ³).....	16.12 (983.7)	
Compression ratio.....	16.5:1	
Dry weight, kg (lb).....	1700 (3748)	
Dry weight with Gen Pac, kg (lb).....	2200 (4850)	
Wet weight, kg (lb).....	1770 (3902)	
Wet weight with Gen Pac, kg (lb).....	2370 (5225)	

Performance	1500 rpm	1800 rpm
with fan, kW (hp) at:		
Prime Power	536 (729)	585 (796)
Max Standby Power	596 (811)	644 (876)

Lubrication system	1500 rpm	1800 rpm
Oil consumption, liter/h (US gal/h) at:		
Prime Power	0.10 (0.026)	0.10 (0.026)
Max Standby Power	0.11 (0.029)	0.11 (0.039)
Oil system capacity incl filters, liter	48	

Fuel system	1500 rpm	1800 rpm
Specific fuel consumption at:		
Prime Power, g/kWh (lb/hph)		
25 %	215 (0.349)	224 (0.363)
50 %	196 (0.318)	201 (0.326)
75 %	196 (0.318)	197 (0.319)
100 %	199 (0.323)	202 (0.327)
Max Standby Power, g/kWh (lb/hph)		
25 %	210 (0.340)	220 (0.357)
50 %	195 (0.316)	200 (0.324)
75 %	196 (0.318)	198 (0.321)
100 %	200 (0.324)	204 (0.331)

Intake and exhaust system	1500 rpm	1800 rpm
Air consumption, m ³ /min (cfm) at:		
Prime Power	44 (1541)	53 (1874)
Max Standby Power	47 (1658)	55 (1937)
Max allowable air intake restriction, kPa (PSI)	5 (0.7)	5 (0.7)
Heat rejection to exhaust, kW (BTU/min) at:		
Prime Power	415 (23601)	472 (26842)
Max Standby Power	463 (26330)	530 (30141)
Exhaust gas temperature after low pressure turbine, °C (°F) at:		
Prime Power	450 (842)	422 (792)
Max Standby Power	463 (865)	461 (862)
Max allowable back-pressure in exhaust line, kPa (PSI)	10 (1.5)	10 (1.5)
Exhaust gas flow, m ³ /min (cfm) at:		
Prime power	101.6 (3586)	119 (4201)
Max Standby Power	111.8 (3949)	130.1 (4593)

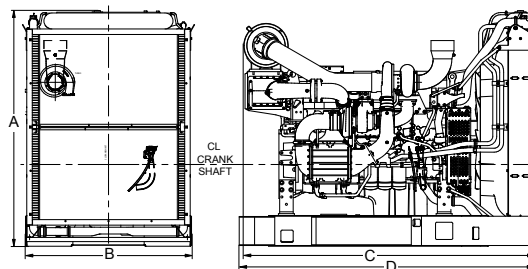
Standard equipment

	Engine	Gen Pac
Engine		
Automatic belt tensioner	•	•
Lift eyelets	•	•
Flywheel		
Flywheel housing with conn. acc. to SAE 1	•	•
Flywheel for 14" flex. plate and flexible coupling	•	•
Vibration dampers	•	•
Engine suspension		
Fixed front suspension	•	•
Lubrication system		
Oil dipstick	•	•
Full-flow oil filter of spin-on type	•	•
By-pass oil filter of spin-on type	•	•
Oil cooler, side mounted	•	•
Low noise oil sump	•	•
Fuel system		
Fuel filters of spin-on type	•	•
Electronic unit injectors	•	•
Pre-filter with water separator	•	•
Intake and exhaust system		
Air filter without rain cover	•	•
Air restriction indicator	•	•
Air cooled exhaust manifold	•	•
Connecting flange for exhaust pipe	•	•
Exhaust flange with v-clamp	•	•
Turbo chargers, dual stage, right side	•	•
Cooling system		
TWD-cooling system	•	•
Belt driven driven coolant pump	•	•
Fan hub	•	•
Pusher fan	-	•
Fan guard	-	•
Belt guard	-	•
Control system		
Engine Management System (EMS) with CAN-bus interface SAE J1939	•	•
CIU, Control Interface Unit	-	-
DCU, Display Control Unit	-	-
Alternator		
Alternator 80A / 24 V	•	•
Starting system		
Starter motor, 7.0kW, 24 V	•	•
Instruments and senders		
Temp. and pressure for automatic stop/alarm	•	•
Other equipment		
Expandable base frame	-	•
Engine Packing		
Plastic wrapping	•	•

- optional equipment or not applicable
• included in standard specification

Dimensions TWD1643GE

Not for installation



A* = 1925 mm / 76 in
B* = 1350 mm / 53.1 in (max width 1401 mm / 55.2 in)
C = 2362 mm / 93 in
D = 2399 mm / 94.5 in (During transport)
D = Max 3255 mm / 128.2 in
* Including radiator and intercooler

Note! Not all models, standard equipment and accessories are available in all countries. All specifications are subject to change without notice. The engine illustrated may not be entirely identical to production standard engines.

Power Standards

The engine performance corresponds to ISO 3046, BS 5514 and DIN 6271. The technical data applies to an engine without cooling fan and operating on a fuel with calorific value of 42.7 MJ/kg (18360 BTU/lb) and a density of 0.84 kg/liter (7.01 lb/US gal), also where this involves a deviation from the standards. Power output guaranteed within 0 to +2% at rated ambient conditions at delivery. Ratings are based on ISO 8528.

Engine speed governing in accordance with ISO 3046/IV, class A1 and ISO 8528-5 class G3

Exhaust emissions

The TWD1643GE is certified for EPA Tier 2. An additional feature is that TWD1643GE fulfills EU Stage 2 exhaust emission levels.

Rating Guidelines

PRIME POWER rating corresponds to ISO Standard Power for continuous operation. It is applicable for supplying electrical power at variable load for an unlimited number of hours instead of commercially purchased power. A10 % overload capability for governing purpose is available for this rating. MAXIMUM STANDBY POWER rating corresponds to ISO Standard Fuel Stop Power. It is applicable for supplying standby electrical power at variable load in areas with well established electrical networks in the event of normal utility power failure. No overload capability is available for this rating.
1 hp = 1 kW x 1.36

Information

For more technical data and information, please look in the Generator Set Engines Sales Guide.

VOLVO PENTA

AB Volvo Penta
SE-405 08 Göteborg, Sweden
www.volvopenta.com

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

Performance

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

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

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	220 0,357
	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	190,0	210,0
	US gal/h	50,2	55,5
Fuel supply line max restriction	kPa	10,0	10,0
	psi	1,5	1,5
Fuel supply line max pressure, engine stopped	kPa	0,0	0,0
	psi		
System return flow	litre/h	25,0	25,0
	US gal/h	6,6	6,6
Fuel return line max restriction	kPa	20,0	20,0
	psi	2,9	2,9
Maximum allowable inlet fuel temp	°C	60	60
	°F	140	140
Prefilter / Water separator micron size	μ	10	
Fuel filter micron size	μ	5	
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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02**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			

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
	Standby Power	kg/s	0,93	10,9
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		kPa		
		psi		
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
	55	12,0	200		
1800	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	-	160	Shut down. ON/OFF*
	1500 rpm	kPa	-	220	Shut down. ON/OFF*
	1800 rpm	kPa	-	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

VOLVO PENTA

TWD 1643GE

Document No

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02**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	