

October 4, 2016

Colorado Department of Public Health and Environment
APCD-SS-B1
4300 Cherry Creek Drive South
Denver, CO 80246-1530

To Whom It May Concern:

Enclosed is an Air Pollutant Emission Notice (APEN) for the installation of four Tier 2 Volvo TWD 1643 GE engines to be operated for emergency only at CoreSite in Denver, CO. The following information is being submitted with this APEN application:

- APCD-213 Diesel RICE Form for each of 4 engines
- APCD-214 NSPS IIII APEN Addendum Form
- Emissions Calculations
- Manufacturer Specifications

CoreSite plans to operate the engines for no more than 225 hours per year as emergency, back-up power to their facility. The engines have been ordered but the serial numbers and manufacture dates of the specific engines to be installed at the facility are not yet known. Due to the need to install quickly once the engines are available, CoreSite is submitting the APEN at this time and will follow up with the specific serial numbers and dates of manufacture for each engine as soon as possible.

Should you have any questions regarding this APEN, please contact myself at 910-622-4206 or garrison.beall@coresite.com or our consultant Trisha Victor at 202-503-7455 or tvictor@powersecure.com.

Thank you,

Garrison Beall
Assistant Project Manager
CoreSite

Criteria Pollutant Emission Factors											
Engine Generator	Capacity	Capacity	Generator Hours	NO _x Emission Factor ¹	CO Emission Factor ¹	VOC Emission Factor ¹	PM Emission Factor ^{1,2}	SO _x Emission Factor ¹	CO2 Emission Factor ¹		
	kW	hp	hr/yr	g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr	lb/bhp-hr	lb/hp-hr		
TWD 1643 GE	674	917	225	7.04	0.51	0.14	9.50E-02	1.21E-05	1.16		
1. Emissions Factors are the maximum of either manufacturer's nominal data (*1.25 to present a NTE value) and from EPA's AP-42 Section 3.2, Table 3.2-1 for SO _x and Table 3.4-1 for CO ₂ .											
2. Conservatively assume PM=PM _{2.5} =PM ₁₀ .											
Total Engine Emissions											
Engine	NO _x Emissions		CO Emissions		VOC Emissions		PM Emissions		SO _x Emissions		CO ² Em
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr
EG 1	10.46	1.18	0.76	0.09	0.20	0.02	0.14	0.02	1.11E-02	1.25E-03	1063.72
EG 2	10.46	1.18	0.76	0.09	0.20	0.02	0.14	0.02	1.11E-02	1.25E-03	1063.72
EG 3	10.46	1.18	0.76	0.09	0.20	0.02	0.14	0.02	1.11E-02	1.25E-03	1063.72
EG 4	10.46	1.18	0.76	0.09	0.20	0.02	0.14	0.02	1.11E-02	1.25E-03	1063.72
TOTAL		4.71		0.34		0.09		0.06		0.01	



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2016 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

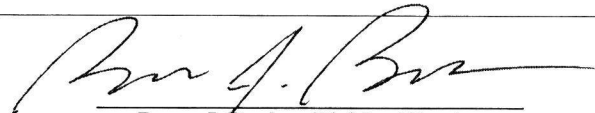
OFFICE OF TRANSPORTATION
AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: AB Volvo Penta
(U.S. Manufacturer or Importer)

Certificate Number: GVPXL16.1ACW-011

Effective Date:
07/31/2015

Expiration Date:
12/31/2016


Byron J. Bunker, Division Director
Compliance Division

Issue Date:
07/31/2015

Revision Date:
N/A

Model Year: 2016

Manufacturer Type: Original Engine Manufacturer

Engine Family: GVPXL16.1ACW

Mobile/Stationary Indicator: Stationary

Emissions Power Category: 560<kW<=2237

Fuel Type: Diesel

After Treatment Devices: No After Treatment Devices Installed

Non-after Treatment Devices: Electronic Control

Pursuant to Section 111 and Section 213 of the Clean Air Act (42 U.S.C. sections 7411 and 7547) and 40 CFR Part 60, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following engines, by engine family, more fully described in the documentation required by 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60.

This certificate does not cover engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

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SVP, Product and Engineering

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Required hardware and software

Operating Systems:	Windows2000? or WindowsXP?
Browsers (for SENDERS):	Internet Explorer 6.0? or above
Browsers (for SIGNERS):	Internet Explorer 6.0?, Mozilla FireFox 1.0, NetScape 7.2 (or above)
Email:	Access to a valid email account
Screen Resolution:	800 x 600 minimum
Enabled Security Settings:	•Allow per session cookies •Users accessing the internet behind a Proxy Server must enable HTTP 1.1 settings via proxy connection

** These minimum requirements are subject to change. If these requirements change, we will provide you with an email message at the email address we have on file for you at that time providing you with the revised hardware and software requirements, at which time you will have the right to withdraw your consent.

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VOLVO PENTA

NO: 164015

EXHAUST EMISSION DECLARATION

The emission data in this declaration are measured according to the test procedures specified below and on one member engine of the engine type. Emission data may vary among production engines.

TECHNICAL SPECIFICATION

Engine type: TWD1643GE
Specification: 869523
Module No: 138052022
Rated crankshaft power *): 674 kW
Rated speed: 1800 rpm
*) Stand-by power without fan acc. to ISO 3046.

TEST INFORMATION

Test conditions: 40 CFR part 89
Test identification: 29003822
Test date: December 4, 2006
Test cycle: 5-mode US constant speed test cycle

EXHAUST EMISSIONS (weighted cycle)

CO (g/kWh)	0,41
HC (g/kWh)	0,11
NOx (g/kWh)	5,63
PM (g/kWh)	0,076

EXHAUST EMISSIONS (per cycle mode)

Mode	#	1	2	3	4	5
Power	(kW)	668	503	335	167	67
NOx	(g/h)	3427	2716	1892	1009	629
HC	(g/h)	43	36	32	31	44
CO	(g/h)	486	179	68	83	155
CO ₂	(kg/h)	441	324	219	120	64
NOx	(ppm)	629	599	540	441	386
HC	(ppm)	23	23	26	40	81
CO	(ppm)	138	61	30	56	147
CO ₂	(%)	7,85	6,93	6,06	5,1	3,8
O ₂	(%)	10	11,23	12,45	13,75	15,55

TA-Luft

Test identification: 29003831
Test date: December 4, 2006

Mode	#	1	2	3	4
Power	(kW)	616	462	308	154
Nox (O ₂)	(g/Nm ³)	1.9	2.1	2.0	2.0
HC (O ₂)	(mg/Nm ³)	20	23	31	51
CO (O ₂)	(mg/Nm ³)	238	110	76	163
PM (O ₂)	(mg/Nm ³)	27	17	13	26

* PM is calculated from multifilter measurements with AVL Smart Sampler.

SMOKE

Opacity (%): Acc: n.a., Lug: n.a., Peak: n.a.

Gothenburg 2006-12-07



Hanna Wahlström

AB Volvo Penta
47 436, Engine Emission Certification

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
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	1:51
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 L _w	No load	dB(A)	113	117
	Prime Power	dB(A)	117	120
	Standby Power	dB(A)	117	120
Calculated sound pressure L _p at 1 m	No load	dB(A)	101	105
	Prime Power	dB(A)	105	108
	Standby Power	dB(A)	105	108

Unsilenced exhaust noiseData calculated as sound pressure L_p.

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

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

VOLVO PENTA**TWD 1643GE**

Document No

21117581

Issue Index

02**Lubrication system**

Lubrication system		r/min	1500	1800
Lubricating oil consumption	Prime Power	litre/h	0,10	0,10
		US gal/h	0,026	0,026
	Standby Power	litre/h	0,11	0,11
		US gal/h	0,029	0,029
Oil system capacity including filters		litre	48	
		US gal	12,7	
Oil sump capacity:	max	litre	42	
		US gal	11,1	
	min	litre	32	
		US gal	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	300 - 650	
		psi	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	215	224
		lb/hph	0,349	0,363
	50%	g/kWh	196	201
		lb/hph	0,318	0,326
	75%	g/kWh	196	197
		lb/hph	0,318	0,319
	100%	g/kWh	199	202
		lb/hph	0,323	0,327
Standby Power Specific fuel consumption at:	25%	g/kWh	210	220
		lb/hph	0,340	0,357
	50%	g/kWh	195	200
		lb/hph	0,316	0,324
	75%	g/kWh	196	198
		lb/hph	0,318	0,321
	100%	g/kWh	200	204
		lb/hph	0,324	0,331

Fuel system

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

VOLVO PENTA**TWD 1643GE**

Document No

21117581

Issue Index

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		m²	1,68	
		foot²	18,08	
CAC radiator core area		m²	1,68	
		foot²	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
		kW		
		BTU/min		
Charge air mass flow	Prime Power	kg/s	0,86	10,5
	Standby Power	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		
		°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
		°C		
		°F		
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		
	58	13,0	0		
1800	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

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	

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

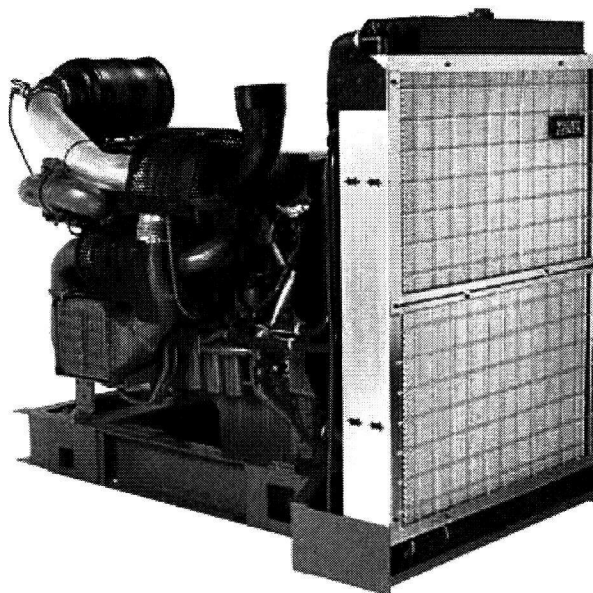
Turbo charger

- 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

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)

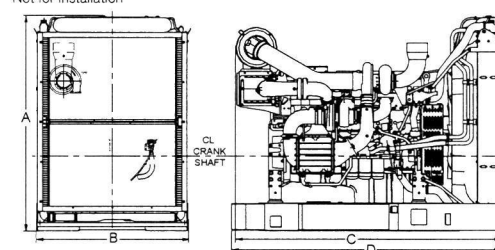
Standard equipment

	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 fulfils 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 Generating Set Engines Sales Guide.

VOLVO PENTA

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



September 16, 2016

Colorado Department of Public Health and Environment
APCD-SS-B1
4300 Cherry Creek Drive South
Denver, CO 80246-1530



To Whom It May Concern:

Enclosed is an Air Pollutant Emission Notice (APEN) for the installation of three Tier 2 Volvo TWD 1643 GE engines to be operated for emergency only at CoreSite in Denver, CO. The following information is being submitted with this APEN application:

- APCD-213 Diesel RICE Form
- APCD-214 NSPS IIII APEN Addendum Form
- Emissions Calculations
- Manufacturer Specifications

CoreSite plans to operate the engines for no more than 250 hours per year as emergency, back-up power to their facility. The engines have been ordered but the serial numbers and manufacture dates of the specific engines to be installed at the facility are not yet known. Due to the need to install quickly once the engines are available, CoreSite is submitting the APEN at this time and will follow up with the specific serial numbers and dates of manufacture for each engine as soon as possible.

Should you have any questions regarding this APEN, please contact myself at 910-622-4206 or garrison.beall@coresite.com or our consultant Trisha Victor at 202-503-7455 or tvictor@powersecure.com.

Thank you,

Garrison Beall
Assistant Project Manager

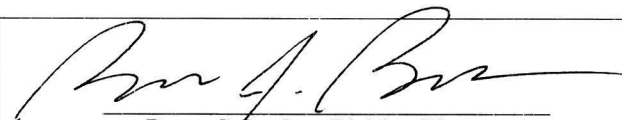


UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2016 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION
AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: AB Volvo Penta
(U.S. Manufacturer or Importer)
Certificate Number: GVPXL16.1ACW-011

Effective Date:
07/31/2015
Expiration Date:
12/31/2016


Byron J. Bunker, Division Director
Compliance Division

Issue Date:
07/31/2015
Revision Date:
N/A

Model Year: 2016
Manufacturer Type: Original Engine Manufacturer
Engine Family: GVPXL16.1ACW

Mobile/Stationary Indicator: Stationary
Emissions Power Category: 560<kW<=2237
Fuel Type: Diesel
After Treatment Devices: No After Treatment Devices Installed
Non-after Treatment Devices: Electronic Control

Pursuant to Section 111 and Section 213 of the Clean Air Act (42 U.S.C. sections 7411 and 7547) and 40 CFR Part 60, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following engines, by engine family, more fully described in the documentation required by 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60.

This certificate does not cover engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

Criteria Pollutant Emission Factors

Engine Generator	Capacity	Capacity	Generator Hours	NO _x Emission Factor ¹	CO Emission Factor ¹	VOC Emission Factor ¹	PM Emission Factor ^{1,2}	SO _x Emission Factor ¹	CO ₂ Emission Factor ¹
	kW	hp		g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr	lb/bhp-hr	lb/hp-hr
TWD 1643 GE	674	917	250	7.04	0.51	0.14	9.50E-02	1.21E-05	1.16

1. Emissions Factors are the maximum of either manufacturer's nominal data (*1.25 to present a NTE value) and from EPA's AP-42 Section 3.2, Table 3.2-1 for SO_x and Table 3.4-1 for CO₂.
2. Conservatively assume PM=PM_{2.5}+PM₁₀.

Total Engine Emissions

Engine	NO _x Emissions		CO Emissions		VOC Emissions		PM Emissions		SO _x Emissions		CO ₂ Emissions	
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
EG 1	10.46	1.31	0.76	0.10	0.20	0.03	0.14	0.02	1.11E-02	1.39E-03	1063.72	132.97
EG 2	10.46	1.31	0.76	0.10	0.20	0.03	0.14	0.02	1.11E-02	1.39E-03	1063.72	132.97
EG 3	10.46	1.31	0.76	0.10	0.20	0.03	0.14	0.02	1.11E-02	1.39E-03	1063.72	132.97
TOTAL		3.92		0.29		0.08		0.05		4.17E-03		398.90

EXHAUST EMISSION DECLARATION

The emission data in this declaration are measured according to the test procedures specified below and on one member engine of the engine type. Emission data may vary among production engines.

TECHNICAL SPECIFICATION

Engine type: TWD1643GE
Specification: 869523
Module No: 138052022
Rated crankshaft power *): 674 kW
Rated speed: 1800 rpm
*) Stand-by power without fan acc. to ISO 3046.

TEST INFORMATION

Test conditions: 40 CFR part 89
Test identification: 29003822
Test date: December 4, 2006
Test cycle: 5-mode US constant speed test cycle

EXHAUST EMISSIONS (weighted cycle)

CO (g/kWh)	0,41
HC (g/kWh)	0,11
NOx (g/kWh)	5,63
PM (g/kWh)	0,076

EXHAUST EMISSIONS (per cycle mode)

Mode	#	1	2	3	4	5
Power	(kW)	668	503	335	167	67
NOx	(g/h)	3427	2716	1892	1009	629
HC	(g/h)	43	36	32	31	44
CO	(g/h)	486	179	68	83	155
CO ₂	(kg/h)	441	324	219	120	64
NOx	(ppm)	629	599	540	441	386
HC	(ppm)	23	23	26	40	81
CO	(ppm)	138	61	30	56	147
CO ₂	(%)	7,85	6,93	6,06	5,1	3,8
O ₂	(%)	10	11,23	12,45	13,75	15,55

TA-Luft

Test identification: 29003831
Test date: December 4, 2006

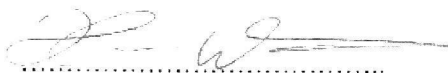
Mode	#	1	2	3	4
Power	(kW)	616	462	308	154
Nox (O ₂)	(g/Nm ³)	1.9	2.1	2.0	2.0
HC (O ₂)	(mg/Nm ³)	20	23	31	51
CO (O ₂)	(mg/Nm ³)	238	110	76	163
PM (O ₂)	(mg/Nm ³)	27	17	13	26

* PM is calculated from multifilter measurements with AVL Smart Sampler.

SMOKE

Opacity (%): Acc: n.a., Lug: n.a., Peak: n.a.

Gothenburg 2006-12-07



Hanna Wahlström

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

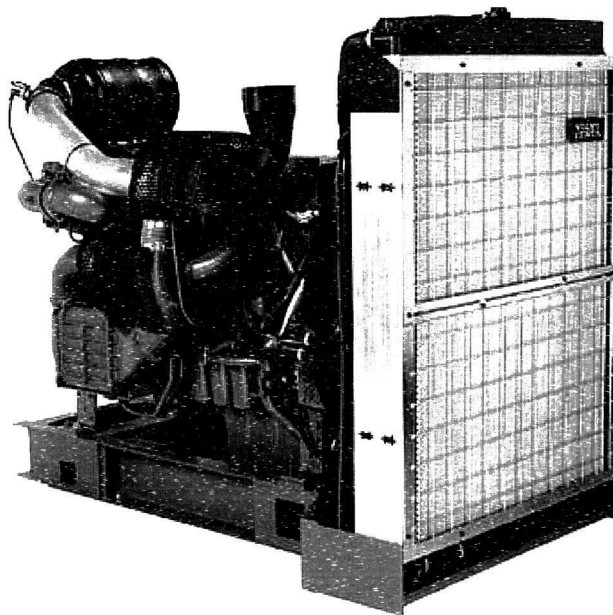
Turbo charger

- 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

VOLVO PENTA

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

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

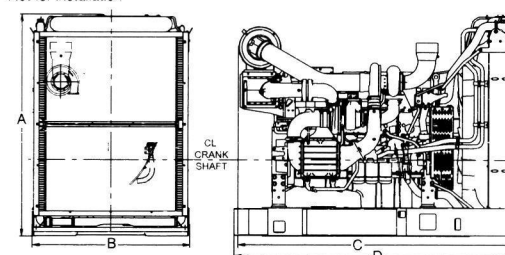
Plastic wrapping

— 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 fulfils 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 Generating 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 16,12

in³ 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

Prime Power

without fan

r/min 1500 1800

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

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 (mR²)

kgm² 4,20lbft² 99,7

Degree of irregularity at:

Prime Power

1:33 1:55

Standby Power

1:29 1:51

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)

Measured sound power Lw

Calculated sound pressure Lp at 1 m

No load

Prime Power

Standby Power

No load

Prime Power

Standby Power

r/min	1500	1800
dB(A)	113	117
dB(A)	117	120
dB(A)	117	120
dB(A)	101	105
dB(A)	105	108
dB(A)	105	108

Unsilenced exhaust noise

Data calculated as sound pressure Lp.

Assumed microphone distance 1 m

Prime Power

Standby Power

r/min	1500	1800
dB(A)	116	120
dB(A)	117	120

Test conditions for load acceptance data

Warm engine.

Generator

Stamford

Model

HCI534F1

Type of AVR

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

Time from start to no load speed at ambient temperature: °C

	r/min	1500	1800
20	s	4,2	6,0
5	s	6,8	7,7
-15*	s	4,8	5,7
20	s		
5	s		
-15*	s		

Time from start to stay within 0.5% of no load speed at ambient temperature: °C

* 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

Lubricating oil consumption

Prime Power

r/min 1500 1800

litre/h 0,10 0,10

US gal/h 0,026 0,026

Standby Power

litre/h 0,11 0,11

US gal/h 0,029 0,029

Oil system capacity including filters

litre 48

US gal 12,7

Oil sump capacity:

max

litre 42

US gal 11,1

min

litre 32

US gal 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 300 - 650

psi 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

Prime Power

Specific fuel consumption at:

25%

r/min 1500 1800

g/kWh 215 224

lb/hph 0,349 0,363

50%

g/kWh 196 201

lb/hph 0,318 0,326

75%

g/kWh 196 197

lb/hph 0,318 0,319

100%

g/kWh 199 202

lb/hph 0,323 0,327

Standby Power

Specific fuel consumption at:

25%

g/kWh 210 220

lb/hph 0,340 0,357

50%

g/kWh 195 200

lb/hph 0,316 0,324

75%

g/kWh 196 198

lb/hph 0,318 0,321

100%

g/kWh 200 204

lb/hph 0,324 0,331

21117581**02****Fuel system**

Fuel to conform to

System supply flow at:

Fuel supply line max restriction

Fuel supply line max pressure, engine stopped

System return flow

Fuel return line max restriction

Maximum allowable inlet fuel temp

Prefilter / Water separator micron size

Fuel filter micron size

Governor type/make, standard

Injection pump type/make

Injection timing std.

Injection timing

r/min 1500 1800

ASTM-D975-No1 and 2-D

JIS KK 2204, EN 590

litre/h 190,0 210,0

US gal/h 50,2 55,5

kPa 10,0 10,0

psi 1,5 1,5

kPa 0,0 0,0

psi

litre/h 25,0 25,0

US gal/h 6,6 6,6

kPa 20,0 20,0

psi 2,9 2,9

°C 60 60

°F 140 140

µ 10

µ 5

Volvo / EMS 2

Delphi / E3

°B.T.D.C

°B.T.D.C

Intake and exhaust system

Air consumption at:

Prime Power

(+25°C and 100kPa)

Standby Power

r/min 1500 1800m³/min 43,65 53,07

cfm 1541 1874

m³/min 46,96 54,85

cfm 1658 1937

kPa 5 5

psi 0,7 0,7

Air filter type

Air filter cleaning efficiency

Heat rejection to exhaust at:

Prime Power

Standby Power

Exhaust gas temperature

after Low Pressure turbine at:

Prime Power

Standby Power

Max allowable back pressure in exhaust line

Exhaust gas flow at:

(temp and pressure after turbine at the corresponding power setting)

Prime Power

Standby Power

Single stage paper cartridge

% 99,85

kW 415 472

BTU/min 23601 26842

kW 463 530

BTU/min 26330 30141

°C 450 422

°F 842 792

°C 463 461

°F 865 862

kPa 10 10

psi 1,5 1,5

m³/min 101,6 119,0

cfm 3588 4202

m³/min 111,8 130,1

cfm 3948 4594

Cooling system

Heat rejection radiation from engine at:

	r/min	1500	1800
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

Heat rejection to charge air coolers

Prime Power

r/min

1500

1800

kW

125

156

BTU/min

7109

8872

Standby Power

kW

142

180

BTU/min

8075

10236

kW

BTU/min

Charge air mass flow

Prime Power

kg/s

0,86

10,5

Standby Power

kg/s

0,93

10,9

kg/s

Charge air inlet temp.

Prime Power

°C

(Charge air temp after turbo compressor)

°F

Standby Power

°C

°F

°C

°F

Charge air temperature.

Prime Power

°C

Inlet manifold, max allowed.

°F

(At air inlet temp. 25 degr. C)

Standby Power

°C

50

50

°F

122

122

°C

°F

Maximum pressure drop over charge air cooler incl. piping

kPa

psi

Charge air pressure

kPa

462

462

(After charge air coolers)

psi

67,01

67,01

Standard charge air cooler core area

m²

foot²

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		
	58	13,0	0		
1800	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

Governor mode

Alternatives

Isochronous / droop

Default setting

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
Action.
Parameter
Unit
Setting range
Default setting
Level
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

kPa

-

150

150

Shut down. ON/OFF*

>1000 rpm

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

Low idle

kPa

-

150

-

pressure

>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

Electrical system

Voltage and type

Alternator:

Starter motor

Starter motor solenoid:

Number of teeth on:

Max wiring resistance main circuit

Inrush current at +20°C

Cranking current at +20°C

Crank engine speed at 20°C

Starter motor battery capacity:

Inlet manifold heater (at 20 V)

Power relay for the manifold heater

make/output

tacho output

drive ratio

pull current

hold current

flywheel

starter motor

max

min at +5°C

r/min

1500

1800

24V / insulated from earth

Amp

Bosch / 80

Hz/alt. Rev

6

3,9 : 1

make

Melco

type

105P70

kW

7,0

Amp

-

Amp

2,3

153

12

mΩ

-

Amp

750

Amp

300

rpm

155

Ah/A

2x225

Ah/A

-

kW

4,0

Amp

1

Power take off

Front end in line with crank shaft max:

Front end belt pulley load. Direction of load viewed from flywheel side:

max left

max down

max right

Timing gear at compressor PTO max:

Speed ratio direction of rotation viewed from flywheel side

Timing gear at servo pump PTO max:

Speed ratio direction of rotation viewed from flywheel side

Timing gear at hydraulic pump PTO max:

Speed ratio direction of rotation viewed from flywheel side

Max allowed bending moment in flywheel housing

Max. rear main bearing load

r/min

1500

1800

Nm

-

lbft

kW

-

-

hp

kW

-

-

hp

Nm

160

lbft

118

1,31:1/ anti-clockwise

Nm

100

lbft

74

Nm

-

lbft

Nm

15000

lbft

11063

N

NA

lbf

2010-09-16