



F36ETVP03.A94 STAGE V



Brochure main description @1500rpm @1800rpm

Application & simbol		Power Generation	
Engine identification main		F36	
Engine identification rating	kW	94	105
Engine features		PG G-Drive	
Emission feature		Tier4B_StageV	

Main characteristics @1500rpm @1800rpm

Emission certification		Tier4B_StageV	
Commercial code (for order)		F36ETVP03.A94	
Technical code (Pregnana productions, if needed)		F5MGL415A	
Technical code (original plant engine code, on engine block)		F5MGL415A*V001	
Technical code family (original plant engine code)		F5MGL415A*V	
Stand-by power (gross) [mech]	kW	94	105
Specific power	kW/l	26,2	29,2
Electric commercial power (estimation alternator power output)	kWe [kVA]	80 [100] (generator eff. 0,92)	92 [115] (generator eff. 0,92)
BMEP	bar	26,1	19,5
Oil consumption on mission (average)	% fuel consumption	0,25	
Cycle		Diesel 4 stroke	
Air charging system pattern		Turbocharged aftercooled	
Number of cylinder		4	
Configuration (cylinder arrangement)		in line	
Bore	mm	102	
Stroke	mm	110	
Stroke / Bore		1,07	
Displacement	l	3,6	
Unit Displacement	l	0,90	
Bore pitch	mm	110	
Valves per cylinder		4	
Cooling system pattern		liquid	
Direction of rotation (looking flywheel)		anti-clockwise	
Compression ratio		17 : 1	
Firing order		1 - 3 - 4 - 2	
Injection type		Direct common rail	
Engine brake configuration		-	
Be10		8000	
Cylinder Head			
Single / Multiple		single	
Material		cast iron	
Head air circulation		reverse-flow	
Intake valve dia.	mm	32,5	
Exhaust valve dia.	mm	32,5	
Camshaft			
Layout		OHV	
Cam carrier		on cylinder block	
Material and Heat treatment		C53 bon - hardness 55 hrc on cammes	
Valve train		OHV valve train with valve pushrod and lower camshaft	



F36ETVP03.A94 STAGE V



Main characteristics		@1500rpm	@1800rpm
Drivetrain (timing system)			gear tappet
Valve actuation			tappet & push rod
Variable valve actuation system			no
Cylinder block (crankcase)			No Structural
Material of cylinder block			cast iron
Type of liners			parent metall cylinder block
Liners replaceable; (slip fit or interference fit)			no
Bearing caps			machined cast iron
Crankcase Ventilation			closed
Oil separator			centrifugal
Crankshaft & counterweights			
Material			GH 90-52-05 AS 15-2218
Acceptable Inertia (clutch)	kgm ²		0,8
Balancing			no
Turbocharger & EGR system			
Turbocharger type			Wastegate, fixed geometry
Turbocharger supplier			BorgWarner
Turbocharger control			WG pneumatic control
Max boost pressure	mbar		2600
Max turbine inlet temperature	°C		740 cont. / 760 peak
Method of cooling the turbocharger			oil lubricated
Turbo protection devices			wastegate and ECU derating
EGR			yes
EGR control strategy			external cooled EGR
Rate			-
Valve			Ø 21
Cooler			water cooler
Control			from engine ECU
Air mass measurement			no
Exhaust flap			
Exhaust flap supplier			-
Actuation type			-
Exhaust flap cooling			-
Switchability (1500-1800 rpm)			
Emission level 1500 rpm			StageV
Emission level 1800 rpm			Tier4B
Front power take off			
PTO type			-
Max torque available from front of crankshaft (no side load)	Nm		-
Power take off on gear train			
SAE A 9 teeth	Nm		-
SAE A 11 teeth	Nm		-
SAE B 13 teeth	Nm		-
SAE B (DIN 5482)	Nm		-
SAE 2B 15 teeth(ANSI B92,1)	Nm		-
References values			
Engine dimension LxWxH (indicative values)	mm		783 x 689 x 846
G-Drive Dimension LxWxH (indicative values)	mm		1111x689x1050



F36ETVP03.A94 STAGE V



Main characteristics		@1500rpm	@1800rpm
Max permissible engine inclination	deg		35
Engine Weight - Dry (no fluids, value purely indicative)	kg		330
Engine Weight - Wet (with fluids, value purely indicative)	kg		365
G-Drive Weight - Dry (no fluids, value purely indicative)	kg		450
G-Drive Weight - Wet (with fluids, value purely indicative)	kg		470
Center of gravity (FFOB or RFOB according to picture, standard engine layout)	mm	x = - 8 ; y = 140 ; z = 190	
Principal moment of inertia (reference on center of gravity ,standard engine layout)	kgm ²	I1 = 14 kgm ² ; I2 = 23 kgm ² ; I3 = 27 kgm ²	
Principal moment of inertia (reference matrix based on center of gravity,standard engine layout)	kgm ²		
Center of gravity (FFOB or RFOB according to picture, standard IPU/G-Drive layout)	mm	x = 6 ; y = 168; z = - 281	
Principal moment of inertia (reference on center of gravity ,standard IPU/G-Drive layout)	kgm ²	I1 = 21 kgm ² ; I2 = 32 kgm ² ; I3 = 40	
Principal moment of inertia (reference matrix based on center of gravity,standard IPU/G-Drive layout)	kgm ²		
Mass moment of inertia - rotating components (excluding flywheel)	kgm ²		
Mass moment of inertia - standard flywheel	kgm ²		1,189
Bending moment on the flywheel housing	Nm		
Bending moment on PTO	Nm		-
Max static mounting surface load	N		N/A
Crankshaft thrust bearing pressure limit			
Intermittent load:	MPa		N/A
Continuous load:	MPa		N/A
Rear main bearing load	MPa		N/A
Max bending moment available from front of the crankshaft:			
0 deg	Nm		100
90 deg	Nm		300
180 deg	Nm		300
Environmental operating conditions			
Max altitude for declared performances	m		1000
Max ambient temperature for declared performances	°C		40
Min guaranteed temperature for cold start w/o any aid (stand alone engine)	°C		- 15
Min guaranteed temperature for cold start with grid heater (stand alone engine)	°C		-25
Min guaranteed temperature for cold start with grid heater and block heater (stand alone engine)	°C		- 32
Time preheating for manifold heater	s	@ -3°C: 0 ; -30°C : 21	
Time post heating for manifold heater	s	@ -3°C: 0 ; -30°C : 200	
Low idle continuous operation time (reccomended)	h		N/A
Engine performance			
Continuous power (gross) [mech]	kW	67,6	75,5
Prime power (gross) [mech]	kW	94	105
Stand-by power (gross) [mech]	kW	94	105
Fan consumption [mech]	kW	2,2	3,8
Continuous power (net) [mech]	kW	66,1	72,9
Prime power (net) [mech]	kW	91,8	101,2



F36ETVP03.A94 STAGE V



Main characteristics		@1500rpm	@1800rpm
Stand-by power (net) [mech]	kW	91,8	101,2
Typical generator output		92%	92%
Generator available power @ Prime power	kW	84,5 (generator eff. 0,92)	93 (generator eff. 0,92)
Generator available power @ Stand by	kW	84,5 (generator eff. 0,92)	93 (generator eff. 0,92)
Power limitation according to ambient conditions			
Ambient temperature above xx°C	%/5°C (xx°C)		2
Altitude > 1000 < 3000m above sea level	%/500m		3
Altitude > 3000m above sea level	%/500m		6
Power limitation due to safety protections			
Max water temperature (Switch on of the MIL lamp)	°C		104
Start derating: switch on of the warning coolant temperature lamp (amber color)	°C		106
Max derating (50% derating) switch on of the high coolant temperature lamp (redcolor)	°C		110
Altitude level: gradual reduction of transient response by smoke map correction from	m		2000
Fuel temperature	°C		70
Intake manifold air temperature	°C		70
ATS Max gas inlet temperature	°C		600
Max allowed exhaust temperature	°C		740°C (760 peak)
Turbine overheating protection	°C		N/A
Turbine overspeed protection	rpm		N/A
Oil temperature protection	°C		125
Oil pressure protection (min engine rpm)	bar		
Fuel System			
Fuel density	kg/l		0,84
Injection system type			common rail
Injection pump manufacturer			BOSCH
Injection model type			common rail
Injection model pump			CP4N1
Injection pressure	bar		1600
Injector			CRI 2-160HW
Injector installation (sleeve, sealing flat or conical)			sealing flat
Injector nozzle			8 x 350
Engine fuel compatibility			See dedicated GOLD Book document on fluids
Feed pump			on high pressure pump
Max flow	l/h		
Nominal feed pressure	bar		1600
Fuel filter			single Cartridge on left side
Delta pressure on fuel filter	bar		@ 350 l/h 0,2
Max continuous allowable fuel temperature (without derating)	°C		70
Max relative pressure at gear pump inlet	bar		N/A
Min relative pressure at gear pump inlet	bar		N/A
Max back flow relative pressure	bar		
Max back flow restriction	bar		
Max heat rejection to return fuel	kW		
Max fuel flow	kg/h	@1500: 20,1 kg/h	@1800: 22 kg/h
Min fuel tank venting requirement	m³/h		
Prefilter / Water separator micron size	µm		>99% @30



F36ETVP03.A94 STAGE V



Air Intake System		@1500rpm	@1800rpm
Aftercooling type (air to air or water to air)			air to air
Interstage cooling type			-
RoA (Temperature raise between ambient and inlet to engine)	°C		10
Filter air intake temperature (warm air ricirculatuion)	°C		40
Max intake manifold temperature	°C		50
Compressor inlet pressure (with new air filter)	hPa		> - 20
Compressor inlet pressure (with dirty air filter)	hPa		> - 50
Air filter type			cartridge
Loads on turbocharger on compressor intake	kg		0
Loads on turbocharger on compressor outlet	kg		0
Charge air flow (max)	kg/h	382	425

Exhaust System		@1500rpm	@1800rpm
Max back pressure (after exhaust flap) @ rated power with clean system	hPa		220
Max mechanical load on turbine flange	kg		0
Max ambient temperature for exhaust flap actuator	°C		-
Max exhaust temperature After Treatment System	°C		740 cont. / 760 peak
Max exhaust flow rate	kg/h	401 (1500 rpm) ; 446 (1800 rpm)	
Energy to exhaust	kW	73,5	64,7

After Treatment System		
After Treatment System		DOC + DPF + SCR-T
POC		not installed
DPF		yes
DOC		yes
SCR		yes
Urea Dosing System		yes
AdBlue mixer		yes
ATS sensors		DeltaP / 2x Temperature sensor Us/Ds DOC / 2x Temperature sensor Us/Ds SCRT / 2x Nox Sensor Us/Ds SCRT
DPF regeneration strategy		active and passive

Lubrication System		
Oil sump capacity	l	8
Max	l	8
Min	l	6
Oil system capacity including filter	l	9,5
Oil pump type		gear pump
Oil pump drive arrangement		driven by gear
Min oil pump flow	l/min	
Max oil pump flow (@rated speed)	l/min	70
Min oil pressure @ low idle (engine oil temp at 120°C)	kPa (bar)	
Min oil pressure @ rated speed (engine oil temp at 120°C)	kPa (bar)	
Max oil pressure @ rated speed (engine oil temp at 120°C)	kPa (bar)	
Max oil temperature @ full load (in main gallery)	°C	125
Max oil pressure peak on cold engine	bar	



F36ETVP03.A94 STAGE V



Lubrication System

Oil cooler type		water cooler
Transducer for indicating oil temperature and pressure		signal from ECU
Max engine angularity - longitudinal / transversal (std oil pan)	deg	35
Allowed engine gradability during installation on vehicle	deg	± 4
Oil servicing intervals	h	600
Oil filter type		spin-on cartridge
Oil filter capacity	l	0,5
Max oil content admitted in blow by gas (after filter)	g/h	< 0,5
Approved engine oil specifications		see dedicated GOLD Book document on fluids
Oil for cold condition mission (T° ambient < -25°C)		see dedicated GOLD Book document on fluids

Cooling system

		@1500rpm	@1800rpm
Type (water to water or air to water)			air to water
Recommended coolant		50% water and 50% coolant (depending on mission)	
Min radiator cap pressure	kPa		100
Warnnig setting first threshold	°C		106
Max additional restriction (cooling system)	Pa		N/A
Air to boil (prime power, open genset configuration)	°C	55°C @1500rpm ; 53°C @1800rpm	
Air to boil (stand by, open genset configuration)	°C		N/A
EGR Cooler water flow (for ΔT=6°C)	l/s		N/A
LP-CAC water flow (for ΔT=6°C)	l/s		N/A

Fan

Diameter	mm	550
Number of blades		10
Drive ratio		1,3
Speed		6 m/s @1500rpm 7,6 m/s @1800rpm
Air flow		1,8m3/s @1500rpm 2,3 m3/s @1800rpm
Power consumption		2,2 kW (@1500rpm) 3,8 kW (@1800rpm)

Radiator

Core dimensions LxWxh	mm	625 x 140 x 820
Dry weight	kg	44,5
Radiator coolant capacity	l	5,5
Optimum coolant temperature range @engine out (50% glycol)	°C	80
Engine Water pump Type		centrifugal pump
Engine water pump drive		driven by belt
Coolant capacity (engine only)	l	5
Coolant capacity (radiator & hoses)	l	N/A
Thermostat type		wax type, BorgWarner
Thermostat position		on cylinder Head
Thermostat opening / fully open temperature	°C	79 ± 2 / 94 ± 2
Recommended coolant circuit pressurization range (relative)	hPa	1000
Coolant engine pressure outlet – inlet (delta pressure, open thermostat, high idle conditions)	hPa	300
Coolant engine pressure outlet – inlet (only with remote thermostat, ex. retarder)	hPa	-
Min coolant pressure (no pressure cap and thermostat closed)	hPa	-



F36ETVP03.A94 STAGE V



Cooling system		@1500rpm	@1800rpm
Coolant water pump inlet pressure (water temperature 60-100°C)	hPa		60
Coolant flow to radiator @rated speed	l/h		N/A
Min coolant expansion space (% total cooling system capacity)	%		N/A
Max coolant flow to accessories @ rated speed from cab heater	l/min		N/A
Engine out coolant to ambient @rated speed	delta °C		N/A
Engine out coolant to ambient @torque speed	delta °C		N/A
Charge air cooler outlet to ambient @max rpm - CAC dT	delta °C		N/A
Coolant engine flow	l/min	111	134

Electrical, Electronic and Control Systems

System voltage	V		12
Engine control unit			MD1CS069
ECU software			P1738_MD1CS069_522.a2l
ECU Vehicle connection			with CAN line
ECU operating range	°C		- 40 + + 125
Temperature of ECU case for <5' after power up	°C		85
ECU rated continuous temperature	°C		80
ECU communication protocol			SAE J1939
Min power supply for ECU operation	V		10
Max power supply for ECU operation	V		16
Battery wire connection resistance value @20°C (from battery to ECU)	mΩ		≤ 70
Diagnostic system			ISO 14229
Min cranking speed TDC @-30°C	rpm		70
Average cranking speed	rpm		110
N° tooth pinion/crown gear			10 / 126
Min battery voltage	V		10
Mean battery voltage	V		14 ± 0,5
Min battery current	Ah		TBC
Mean battery current	Ah		101
Max starting circuit resistance (to starter)	mΩ		< 70

Cold starting

Without air preheating	°C		- 15
With air preheating (if available)	°C		- 25

Emission gaseus and particulates

NOx (Oxides of nitrogen) [NRSC]	g/kWh		
HC (Hydrocarbons) [NRSC]	g/kWh		
NOX+HC [NRSC]	g/kWh		
CO (Carbon monoxide) [NRSC]	g/kWh		
PM (Particlutes) [NRSC]	g/kWh		
CO2 (Carbon Dioxide) [NRSC]	g/kWh		
NOx (Oxides of nitrogen) [NRTC]	g/kWh		
HC (Hydrocarbons) [NRTC]	g/kWh		
NOX+HC [NRTC]	g/kWh		
CO (Carbon monoxide) [NRTC]	g/kWh		



F36ETVP03.A94 STAGE V



Emission gaseus and particulales

PM (Particlutes) [NRTC]	g/kWh
CO2 (Carbon Dioxide) [NRTC]	g/kWh

Maintenance

Oil drain interval	see dedicated GOLD Book document on fluids
Oil filter change	600 h
Oil refilling time	daily check to evaluate oil refill necessity
CCV filter change	1800 h
Fuel filter change	600 h
Fuel pre-filter change	600 h
Belt replacement	3000 h
Valve lash check /adjustment	for life
AdBlue filter Change	see dedicated GOLD Book document on fluids
DPF filter service	600 h
Coolant change	3000 h

Engine Noise

Overall sound pressure (engine only)	dBA	92,5
Overall sound pressure (with accessories only)	dBA	N/A
Exahust noise (w/o Muffler)	dBA	N/A
Noise spectrum (octave analysis performed at the position of maximum noise) - diagram	Table dB-Hz	N/A

Step Load

		@1500rpm	@1800rpm
G1 (% of PrP)	%	-	77
G2 (% of PrP)	%	61	66
G3 (% of PrP)	%	50	56
G1 (% of PrP) [open flap]	%	N/A	N/A
G2 (% of PrP)[open flap]	%	N/A	N/A
G3 (% of PrP)[open flap]	%	N/A	N/A
G1 (% of PrP) [closed flap]	%	N/A	N/A
G2 (% of PrP) [closed flap]	%	N/A	N/A
G3 (% of PrP) [closed flap]	%	N/A	N/A
Removal load (G1)	%	N/A	N/A
Removal load (G2)	%	N/A	N/A
Removal load (G3)	%	N/A	N/A
Emergency (xxx)	%	N/A	N/A
Emergency (xxx)	%	N/A	N/A
Emergency (xxx)	%	N/A	N/A

Maximum Rating Performance Data

		@1500rpm	@1800rpm
Torque	Nm	609	557
Ambient Temperature	°C	25	25
EGR Rate	%	<10	<10
Fuel Flow	g/s	5,6	6,1
Fuel consumption (BSFC) (prime power)	(kg/h) [g/kWh]	[210]	[210]
Fuel consumption (BSFC) (stand by)	(kg/h) [g/kWh]	[209]	[210]
Fuel consumption (BSFC) (80% prime power)	(kg/h) [g/kWh]	[205]	[204]
Fuel consumption (BSFC) (50% prime power)	(kg/h) [g/kWh]	[206]	[209]
Fuel consumption (BSFC) (25% prime power)	(kg/h) [g/kWh]	[234]	[243]



F36ETVP03.A94 STAGE V



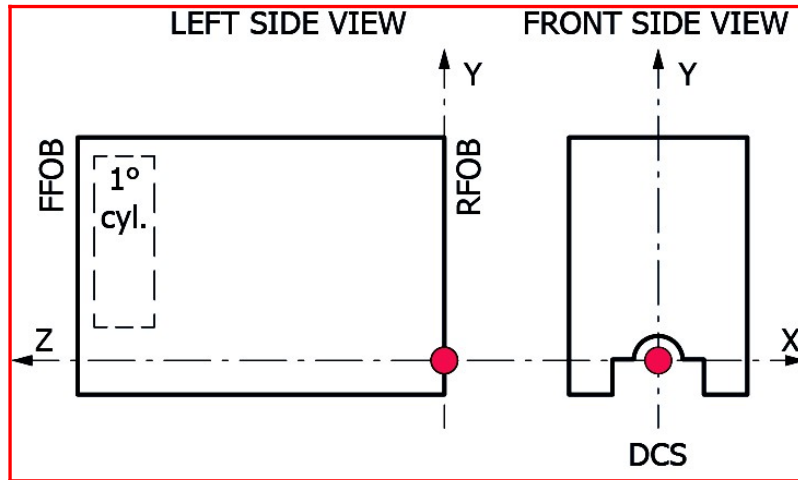
Maximum Rating Performance Data		@1500rpm	@1800rpm
AdBlue consumption (prime power)	% of fuel cons	4,3	4,2
AdBlue consumption (stand by)	% of fuel cons	3,5	3,6
AdBlue consumption (80% prime power)	% of fuel cons	4,5	4,7
AdBlue consumption (50% prime power)	% of fuel cons	6,1	5
AdBlue consumption (25% prime power)	% of fuel cons	4	3
Exhaust Gas Flow	kg/h	401	446

Design air handling system data		@1500rpm	@1800rpm
EGR flow	kg/h		
EGR pressure	kPa		
Boost pressure (compressor outlet)	kPa		
Pressure drop on charge air cooling system	kPa		
Max temperature after HP-Compressor	°C		
Boost temperature (includes EGR effect)	°C		
Back pressure before DOC	kPa		
Exhaust Gas Temp between HP-TC	°C		
Max Exhaust Gas Temp (after TC)	°C		
Max admitted back pressure after SCR	kPa		
Max admitted back pressure after TC	kPa		
Power engine coolant without EGR & CAC (prime power)	kW [kcal/kWh]		
Power engine coolant without EGR & CAC (stand by)	kW [kcal/kWh]		
Power high Temperature EGR Cooler (engine water) (prime power)	kW [kcal/kWh]		
Power high Temperature EGR Cooler (engine water) (stand by)	kW [kcal/kWh]		
Power to coolant due to EGR LP-Circuit (prime power)	kW [kcal/kWh]		
Power to coolant due to EGR LP-Circuit (stand by)	kW [kcal/kWh]		
Total Power to coolant (prime power)	kW [kcal/kWh]	56	58,5
Total Power to coolant (stand by)	kW [kcal/kWh]	56	58,5
Total pump water flow	l/s	111	134
Radiator Coolant Flow (5% less if continuous deaerating system, coolant according to FPT norms)	l/min		
EGR Cooler water flow (for $\Delta T=6^{\circ}C$)	l/s		
LP-CAC water flow (for $\Delta T=6^{\circ}C$)	l/s		
Power in CAC (air to air) (prime power)	kW [kcal/kWh]	13,1	13,9
Power in CAC (air to air) (stand by power)	kW [kcal/kWh]	14,4	15,3
Power Radiated	kW	13	13,4

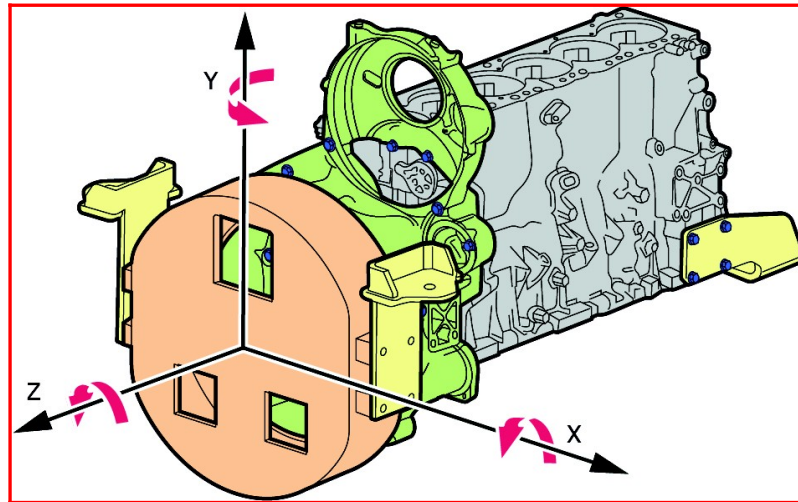
Images



F36ETVP03.A94 STAGE V



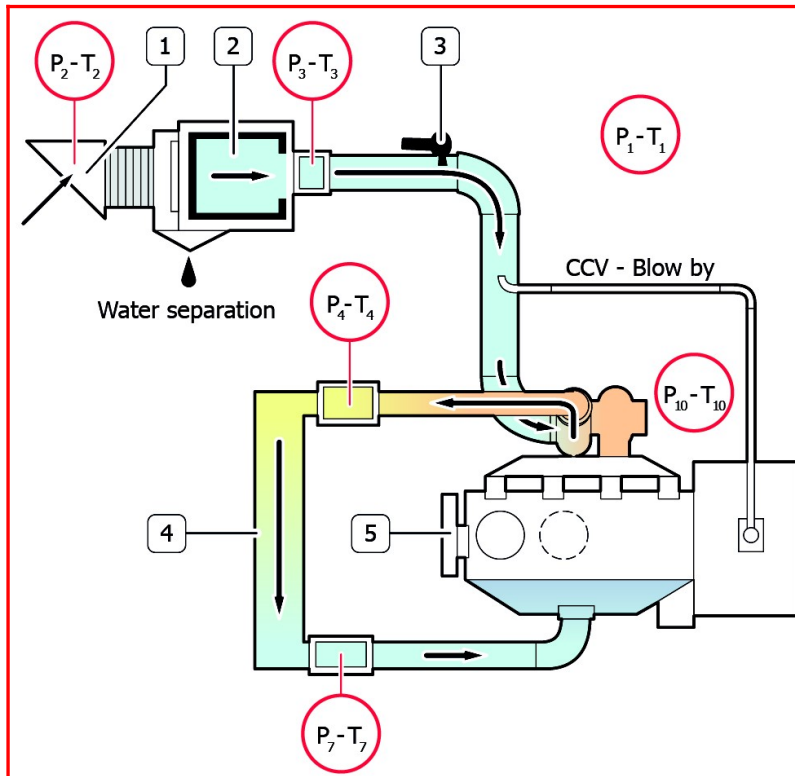
Principal Moment of Inertia



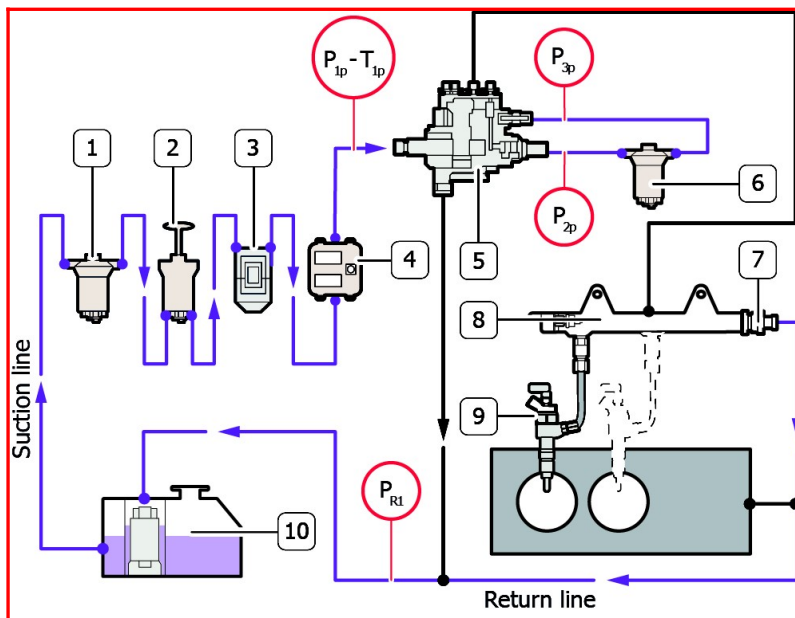
Components



F36ETVP03.A94 STAGE V



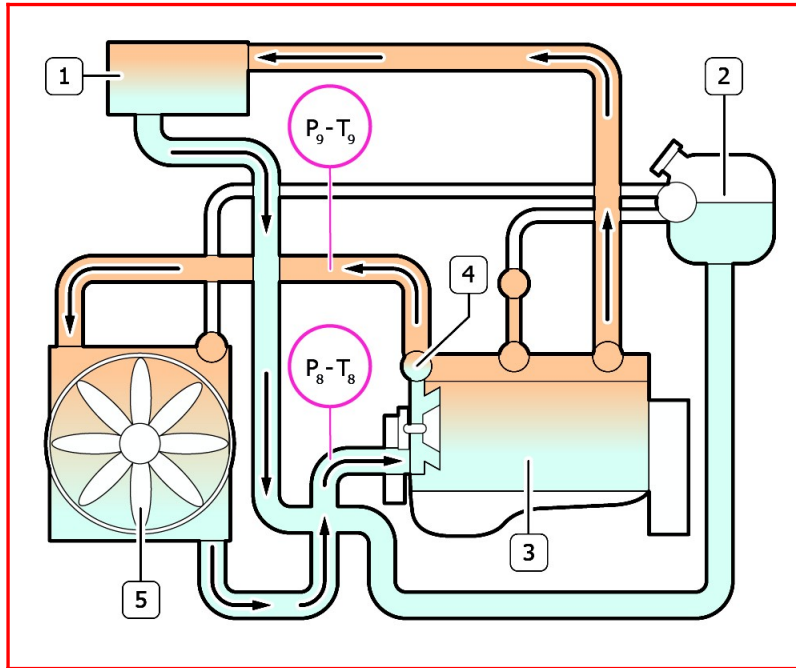
1.Snorkel 2.Air Filter 3.Humidity sensor 4.Intercooler



1.Inspection glass with strainer 2.Prime pump 3.Pre-filter with water separator 4.ECU 5.High Pressure pump 6.Fuel Filter 7.Overpressure valve 8.Common Rail 9.Injectors 10.Fuel tank



F36ETVP03.A94 STAGE V



1.Heating element 2.Expansion tank 3.Engine 4.Thermostat 5.Radiator



ACRONYMS LIST

Acronyms	Description
-	Not Needed
2stTC	Two Stage Turbo (sequential)
Ag	Agricultural
ASC	Ammonia Slip Catalyst (same as CUC)
ATS	After Treatment System
BSFC	Brake Specific Fuel Consumption
CAC	Charge Air Cooler
CCDPF	Close Coupled DPF
CCV	Crankcase Ventilation
CE	Construction Equipment
CI	Cast Iron
CRS	Common Rail System
CRSN	Common Rail System NKW (Commercial vehicles)
CUC	Clean Up Catalyst for ammonia (same as ASC)
DAVNT	Dual Axis Variable Nozzle Turbine
DCS	Drawing Coordinate System
DI	Direct Injection
DOC	Diesel Oxidation Catalyst
DOHC	Double Over Head Camshaft
DPF	Diesel Particulate Filter
ECEGR	External Cooled EGR
ECU	Engine Control Unit
EEGR	External EGR
EGR	Exhaust Gas Recirculation
epWG	Electro pneumatic WG
eVGT	Electrical VGT
eWG	Electrical WG
FFOB	Front Face of Block
FGT	Fixed Geometry Turbocharger (no WG)
FIE	Fuel Injection System
HD	Heavy Duty
HLA	Hydraulic Lash Adjusters
IDI	Indirect Injection

Acronyms	Description
IEGR	Internal EGR
IPU	Industrial Power Unit
ISC	Interstage Cooling
LD	Light Duty
LDCV	Light Duty Commercial Vehicles
LH	Left Hand Side
LWR	Laser Welded Rail
MD	Medium Duty
n/a	Not Available
NA	Natural Aspirated
NS	Non Structural
OHV	Over Head Valves
OPT	Option
PCP	Peak Cylinder Pressure
PTO	Power Take Off
RFOB	Rear Face of Block
RH	Right Hand Side
S	Structural
SAPS	Sulphated Ash, Phosphorus, Sulphur
SCR	Selective Catalytic Reduction catalyst
SCRoF	SCR on filter
SOHC	Single Over Head Camshaft
STD	Standard
TC	Turbocharged
TCA	Turbocharged, Charge Air Cooled
THM	Thermal Management
UFDPF	Under Floor DPF
UQS	Urea Quality Sensor
VE	Bosch Distributor Mechanical Pump
VFT	Variable Flow Turbine
VGT	Variable Geometry Turbocharger
WG	Waste Gate Turbocharger
XPI	Extra high Pressure Injection (Scania, Cummins)

Unit of misure according to international system of unit. Engine accessories and Options available on Option List. All data is subject to change without notice.

UPDATING

Revision	Description	Date
Revision 1.5_Jun 2021		July/2021
Revision 1.6_Jul 2021		July/2021