

Technical Data

4000 Series

4016-61TRG1

4016-61TRG2

4016-61TRG3

Diesel Engine

1500 rev/min

Basic technical data

Number of cylinders ... 16
 Cylinder arrangement ... 60° Vee
 Cycle ... 4 stroke
 Induction system ... turbocharged, air to water charge cooled
 Combustion system ... direct injection
 Compression ratio ... 13:1
 Bore ... 160 mm
 Stroke ... 190 mm
 Cubic capacity ... 61.123 litres
 Direction of rotation ... anti-clockwise viewed on flywheel
 Firing order ... 1A, 1B, 3A, 3B, 7A, 7B, 5A, 5B
 ... 8A, 8B, 6A, 6B, 2A, 2B, 4A, 4B
 Cylinder 1 ... furthest from flywheel

Total weight of Electrounit

Engine
 - dry ... 5570 kg
 - wet ... 5847 kg
 Overall dimensions of electrounit
 Height ... 2128 mm
 Length ... 3302 mm
 Width ... 1723 mm

Centre of Gravity (all engines)

Forward of rear face of cylinder block ... 900
 Above crankshaft centre line ... 50

Moment of inertia (mk²)

-engine ... 11.15 kgm²
 -flywheel ... 9,57 kgm²

Cyclic irregularity for engine/flywheel

-4016-61TRG1 ... 1:290
 -4016-61TRG2 ... 1:277
 -4016-61TRG3 ... 1:260

Ratings

Electrical ratings are based on average alternator efficiency and are for guidance only. (0.8 power factor being used).

Operating point

Engine speed ... 1500 rev/min
 Inlet manifold mixture temperature ... 45 °C
 Cooling water exit temperature ... < 98 °C

Fuel data

To conform to BS2869 class A2 or BS EN590

Performance

Steady state speed stability at constant load ... ± 0,25%
 All data based on operation to ISO 3046/1, BS 5514 and DIN 6271 standard reference conditions.

Governing type ... Digital speed governor

Noise

Estimated sound pressure level no inlet or exhaust at 1 m
 -4016-61TRG1 ... 110 dB(A)
 -4016-61TRG2 ... 111 dB(A)
 -4016-61TRG3 ... 112 dB(A)

Test conditions

-air temperature ... 25 °C
 -barometric pressure ... 100 kPa
 -relative humidity ... 30%
 -air inlet restriction at maximum power (nominal) ... 2.5 kPa
 -exhaust back pressure at maximum power (nominal) ... 3 kPa
 -fuel temperature (inlet pump) ... 58 °C Max.

General installation 4016-61TRG1

Designation	Units	Baseload	Prime	Standby
Gross engine power	kWm	1269	1648	1774
Fan and battery charging alternator power	kW	90		
Net engine power	kWm	1179	1558	1684
Brake mean effective pressure	kPa	1661	2157	2322
Combustion air flow	m ³ /min	122	155	165
Exhaust gas temperature maximum after turbocharger	°C	375	400	420
Exhaust gas flow (max)	m ³ /min	400		
Boost pressure ratio	:1	3.62		
Mechanical efficiency	%	94.0		
Overall thermal efficiency (net)	%	41.5	41.5	41.5
Friction and pumping power losses	kWm	160		
Mean piston speed	m/s	9.5		
Engine coolant flow - minimum	l/s	23		
Typical GenSet electrical output (0.8pf)	kVA	1400	1850	2000
	kWe	1120	1480	1600
Assumed alternator efficiency	%	95		

General installation 4016-61TRG2

Designation	Units	Baseload	Prime	Standby
Gross engine power	kWm	1437	1774	1985
Fan and battery charging alternator power	kW	90		
Net engine power	kWm	1347	1684	1895
Brake mean effective pressure	kPa	1881	2322	2598
Combustion air flow	m ³ /min	131	158	175
Exhaust gas temperature maximum after turbocharger	°C	425	457	489
Exhaust gas flow (max)	m ³ /min	490		
Boost pressure ratio	:1	3.91		
Mechanical efficiency	%	94.0		
Overall thermal efficiency (net)	%	41	41	41
Friction and pumping power losses	kWm	160		
Mean piston speed	m/s	9.5		
Engine coolant flow - minimum	l/s	23		
Typical GenSet electrical output (0.8pf)	kVA	1600	2000	2250
	kWe	1280	1600	1800
Assumed alternator efficiency	%	95		

General installation 4016-61TRG3

Designation	Units	Baseload	Prime	Standby
Gross engine power	kWm	1600	1975	2183
Fan and battery charging alternator power	kW	100		
Net engine power	kWm	1500	1875	2083
Brake mean effective pressure	kPa	2094	2585	2857
Combustion air flow	m ³ /min	135	160	175
Exhaust gas temperature maximum after turbocharger	°C	460	475	560
Exhaust gas flow (max)	m ³ /min	490		
Boost pressure ratio	:1	4		
Mechanical efficiency	%	94.0		
Overall thermal efficiency (net)	%	40	40	40
Friction and pumping power losses	kWm	160		
Mean piston speed	m/s	9.5		
Engine coolant flow - minimum	l/s	23		
Typical GenSet electrical output (0.8pf)	kVA	1800	2250	2500
	kWe	1440	1800	2000
Assumed alternator efficiency	%	96		

Notes:

- All quoted gross engine powers include an allowance of 1.5% for installation variances
- Not to be used for CHP design purposes (indicative figures only). Consult Perkins Engines Stafford Limited. Assumes complete combustion.

Rating Definitions

Baseload power

Unlimited hours usage with an average load factor of 100% of the published baseload power rating.

Prime power

Variable load. Unlimited hours usage with an average load factor of 80% of the published prime power over each 24 hours period. A 10% overload is available for 1 hour in every 12 hours.

Standby power

Limited to 500 hours annual usage with an average load factor of 80% of the published standby power rating over each 24 hour period. Up to 300 hours of annual usage may be run continuously. No overload is permitted on standby power.

Emission capability

All 4016-61TRG ratings are optimised to "Best Fuel Consumption" and do not comply to harmonised International regulation emission limit. More information on these statements can be obtained by contacting the applications department at Perkins Engines Co Ltd.

Energy balance

4016-61TRG1

Designation	Units	Baseload power	Prime power	Standby power
Energy in fuel	kWt	3082	4104	4415
Energy in power output (gross)	kWb	1269	1648	1792
Energy to cooling fan	kWm	90		
Energy in power output (net)	kWm	1179	1558	1702
Energy to exhaust	kWt	900	1149	1225
Energy to coolant and oil	kWt	480	620	666
Energy to radiation	kWt	90	117	131
Energy to charge cooler	kWt	343	570	601

4016-61TRG2

Designation	Units	Baseload power	Prime power	Standby power
Energy in fuel	kWt	3567	4420	4939
Energy in power output (gross)	kWb	1437	1774	1985
Energy to cooling fan	kWm	90		
Energy in power output (net)	kWm	1347	1684	1895
Energy to exhaust	kWt	1030	1240	1380
Energy to coolant and oil	kWt	535	670	750
Energy to radiation	kWt	110	130	139
Energy to charge cooler	kWt	455	606	685

4016-61TRG3

Designation	Units	Baseload power	Prime power	Standby power
Energy in fuel	kWt	4022	4951	5458
Energy in power output (gross)	kWb	1600	1975	2183
Energy to cooling fan	kWm	100		
Energy in power output (net)	kWm	1500	1875	2083
Energy to exhaust	kWt	1136	1400	1535
Energy to coolant and oil	kWt	614	757	830
Energy to radiation	kWt	117	135	160
Energy to charge cooler	kWt	555	684	750

Note: Not to be used for CHP design purposes (indicative figures only). Consult Perkins Engines Company Limited.

Cooling system

Recommended coolant: 50% inhibited ethylene glycol or 50% inhibited propylene glycol and 50% clean fresh water. For CHP systems and where there is no likelihood of ambient temperature below 10 °C, then clean soft water may be used, treated with 1% by volume

Maximum pressure in crankcase water jacket ... 170 kPa
 Maximum top tank temperature (standby) ... 98°C
 Maximum static pressure on pump ... 70 kPa

Total jacket coolant capacity

Electrounit (engine only) ... 95 litres
 Maximum permissible restriction to coolant pump flow... 30 kPa
 Thermostat operating range... 71 - 85°C
 Ambient cooling clearance (standby power) based on air temperature at fan of 6°C above the ambient ... dependent on radiator selection

Temperature rise across the engine (standby power) with Inhibited coolant @ 1500 rev/min ... 5 - 9°C depending on rating
 Coolant temperature shutdown switch setting ... 101°C Rising
 Coolant immersion heater capacity (2 of) ... 4 kWe each

Water jacket cooling data

Coolant flow ... 21 l/s
 Coolant exit temperature (Max.) ... 98°C
 Coolant inlet temperature (Min.) ... 70°C
 Coolant inlet temperature (Max.) ... 80°C
 Water jacket coolant pump
 Speed ... 1.4 x e rev/min
 Method of drive ... engine driven

Secondary water circuit

Coolant flow ... 12 l/s
 Maximum permissible restriction to coolant pump flow... 30 kPa
 Coolant exit temperature (Max.) ... dependent on ambient
 Coolant inlet temperature (Min.) ... 10°C
 Coolant inlet temperature (Max.) ... refer to derate charts

Lubrication system

Recommended SAE viscosity:
 Multigrade oil conforming to the following must be used API CG 15W/40 CH4.

Note: For additional notes on lubricating oil specifications, refer to the OMM manual.

Total system capacity

Maximum sump capacity ... 214 Litres
 Minimum sump capacity ... 147 Litres
 Oil temperature at normal operating conditions ... 95°C
 Oil temperature (in rail) maximum continuous operation ... 105°C

Lubricating oil pressure

At rated speed ... 400 kPa
 Minimum @ 80°C... 340 kPa
 Oil filter screen spacing... 40 microns
 Sump drain plug tapping size ... G1
 Oil pump speed and drive method ... 1.4 x e r/min engine driven
 Shutdown switch - pressure setting ... 193 kPa Falling

Oil consumption

Prime power after running in (typically after 250 hours) 0.52 g/kWhr
 Oil flow rate from pump ... 6.7 litres / sec

Fuel system

Recommended fuel to conform to ..BSEN590 or BS2869 Class A2 Injection system... direct
 Fuel injection pump ... Combined unit injector
 Injector pressure... 140 Mpa
 Lift pump type... Tuthill TCH 5
 Fuel delivery ... 1380 l/hr
 Heat retained in fuel to tank ... 14 kW
 Fuel inlet temperature to be less than ... 58°C
 Maximum suction head at pump inlet... 2.5 m
 Maximum static pressure head ... see manual
 Fuel filter spacing ... 10 microns
 Governor type... Electronic
 Governing to ... ISO 8528-5 2004
 Torque at the governor output shaft ... 1.631 kgm
 Tolerance on fuel consumption to ... ISO 8528-1 1993

Fuel consumption

Note: Fuel consumption calculated on gross rated powers, based on an assumed density of 0.862.

4016-61TRG1

	g/kWh	l/hr
Standby	201	414
Prime power	201	385
Base load power	206	303
At 75% of prime power	209	300
At 50% of prime power	207	198
At 25% of Prime power	230	110

4016-61TRG2

	g/kWh	l/hr
Standby	207	477
Prime power	205	421
Base load power	205	344
At 75% of prime power	206	337
337	210	216
At 25% of Prime power	225	116

4016-61TRG3

	g/kWh	l/hr
Standby	209	528
Prime power	205	473
Base load power	200	373
At 75% of prime power	200	346
At 50% of prime power	204	235
At 25% of Prime power	220	127

Induction system

Maximum air intake restriction of engine:

Clean filter	1.24 kPa
Dirty filter	3.71 kPa
Air filter type	Donaldson

Exhaust system

Exhaust outlet size (internal)	2 x 254 mm
Exhaust outlet flange size	10 inch table D
Back pressure for total system	4 kPa

Electrical system

Voltage	24
Alternator type	Insulated return
Alternator output	40 amps
Starter type	2 X 24 Volt electric
Starter motor power	16.4 kW
Number of teeth on flywheel (may change with flywheel)	156
Number of teeth on starter pinion	12
Minimum cranking speed	120 rev/min
Starter solenoid pull-in current @ -25 °C Max	30 amps
Starter solenoid hold-in current @ -25 °C Max	9 amps
Stop solenoid hold-in current	1.1 amps

Cold start recommendations

Down to 0 °C

Oil	SAE grade API CG 15W/40 CH4
Starter type	2 x 24V
Battery	4 x 12V x 286Ah
Max breakaway current	2000 amps
Cranking current	957 amps
Minimum mean cranking speed	120 rev/min
AIDS	Block heaters

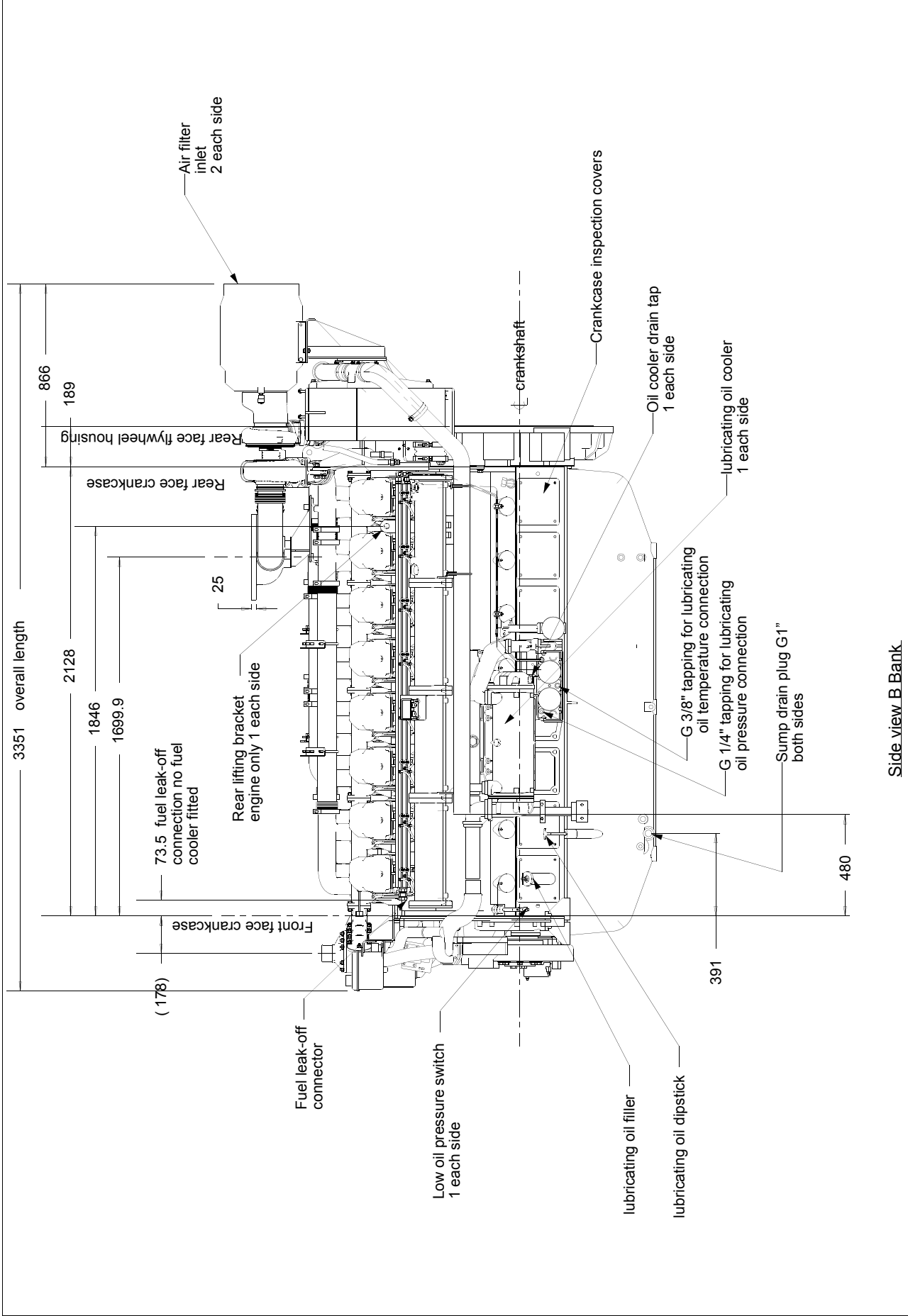
Notes:

- Battery capacity is defined by the 20 hour rate
- The oil specification should be for the minimum ambient temperature as the oil will not be warmed by the immersion heater
- Breakaway current is dependent on the battery capacity available. Cable should be capable of handling the transient current which may be up to double the steady cranking current.

Mountings

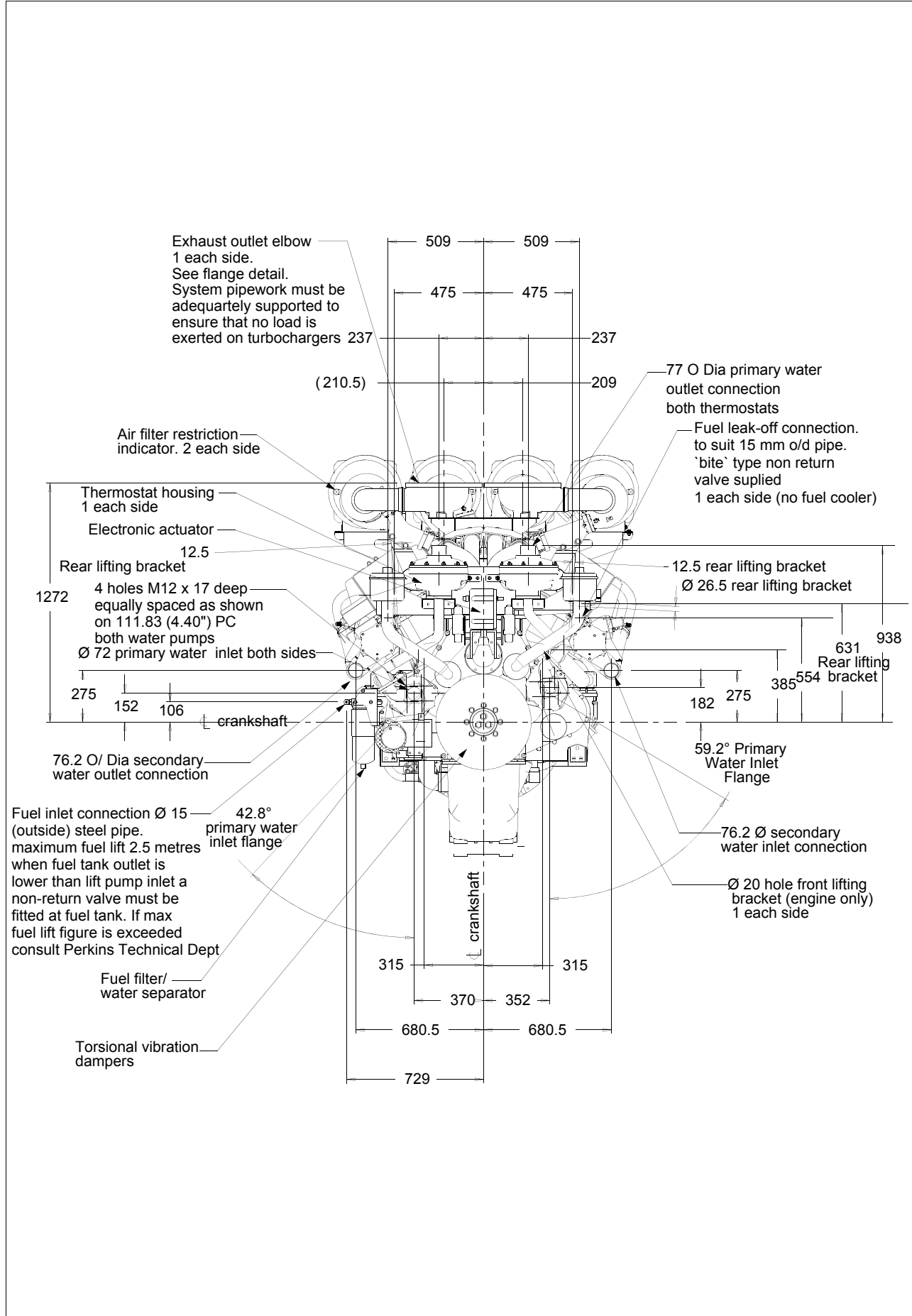
Maximum static bending moment at rear face of block ... 1356 Nm

4016-61TRG - Left hand view

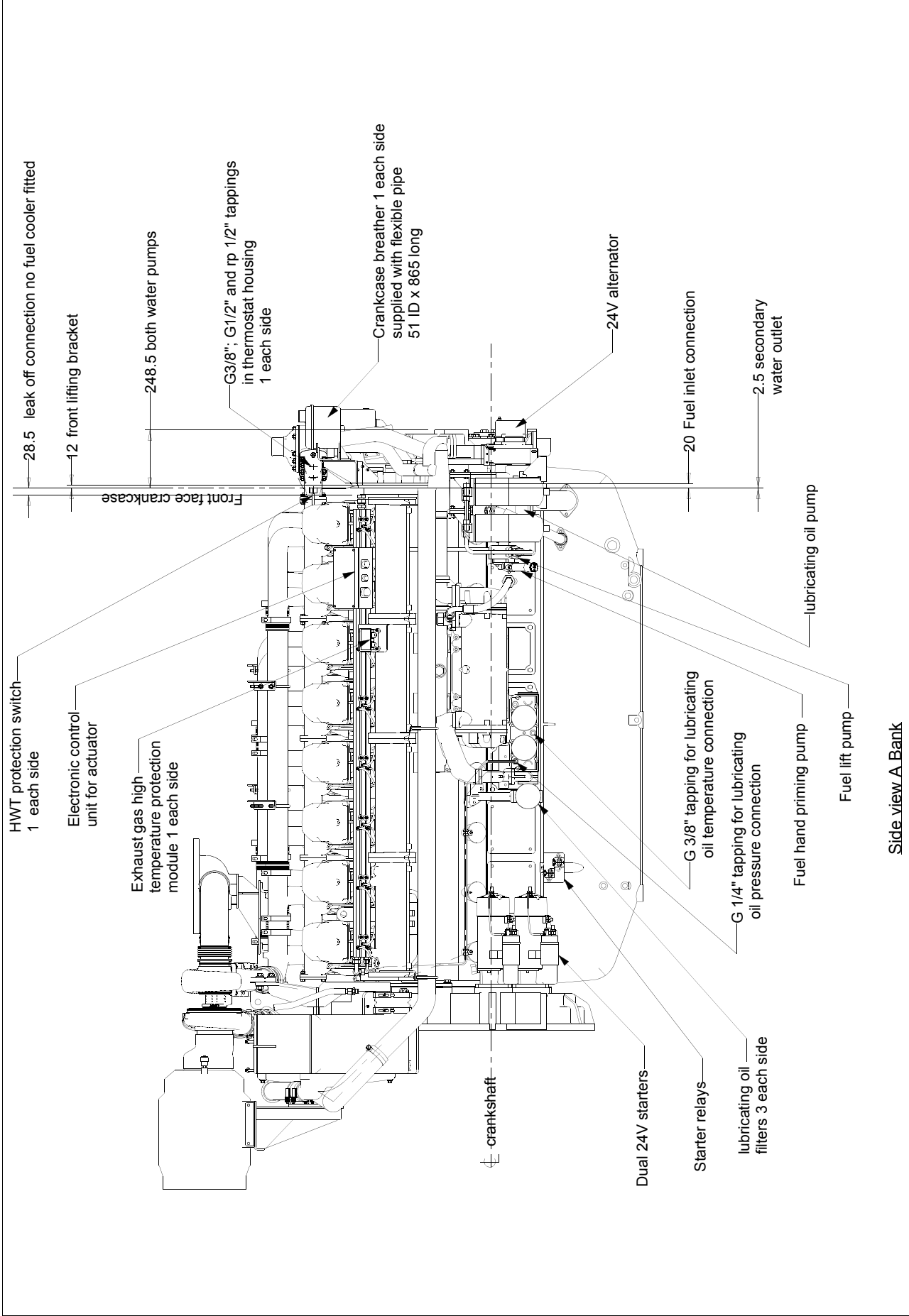


Side view B Bank

4016-61TRG - Front view

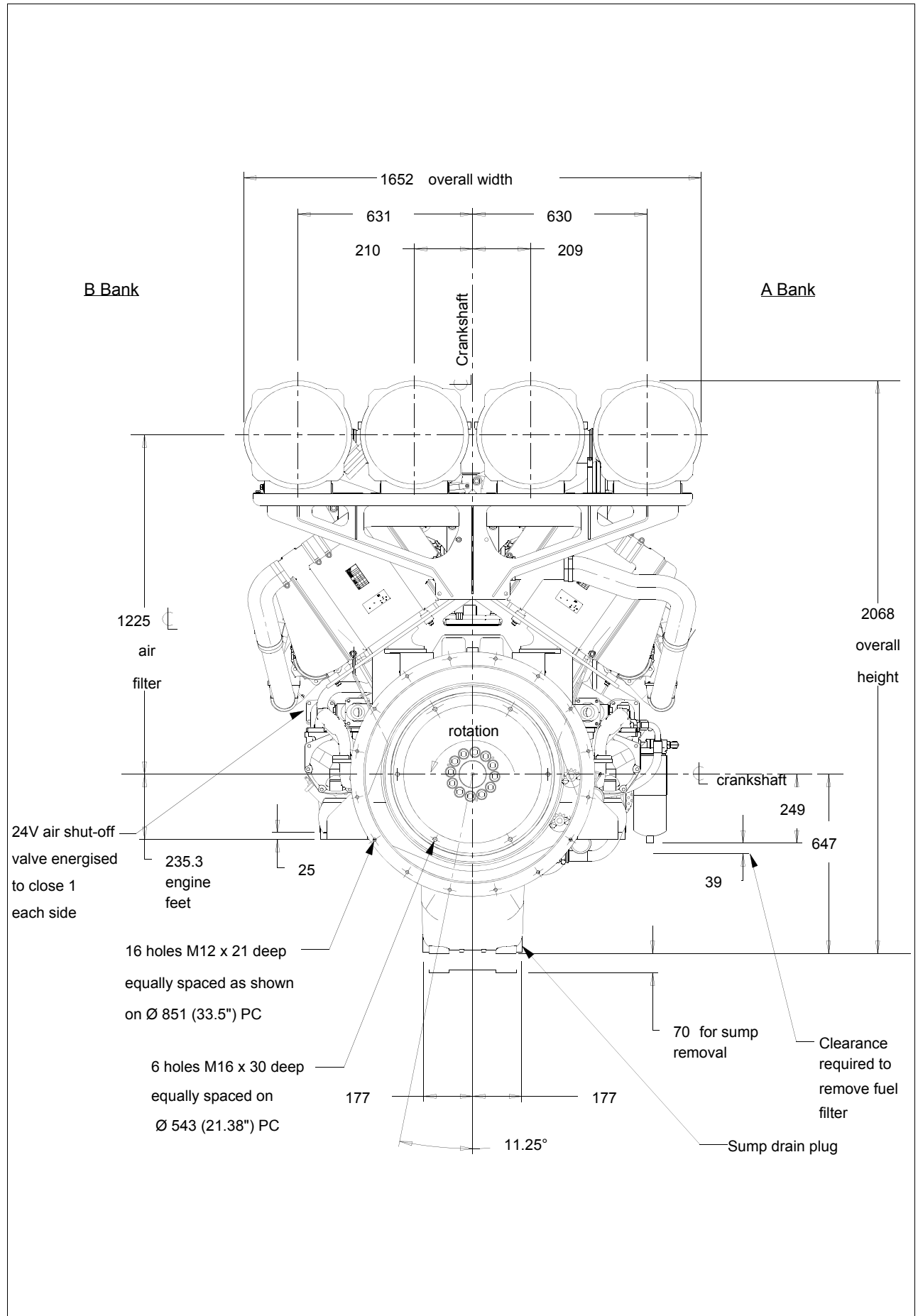


4016-61TRG1 - Right hand view

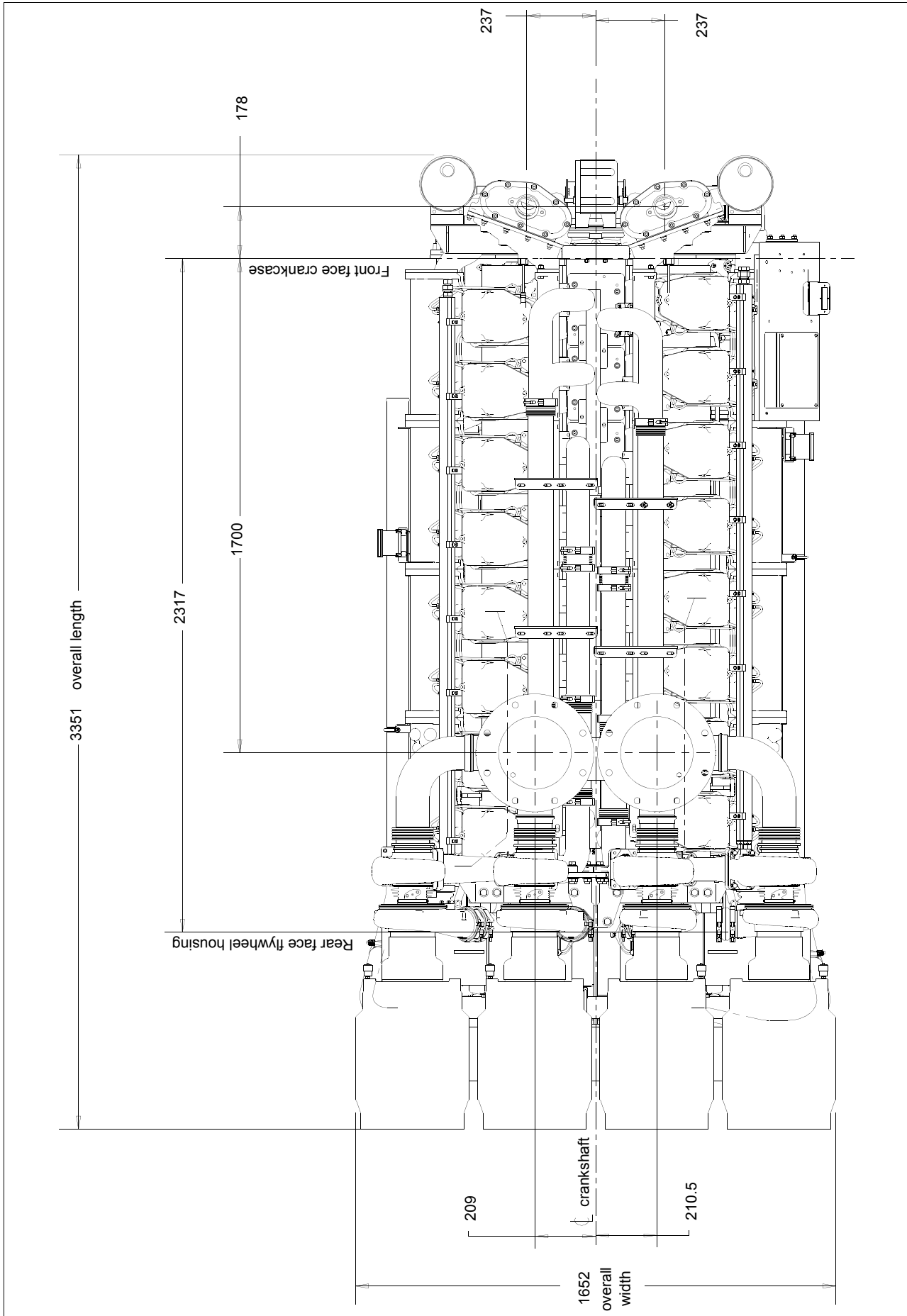


Side view A Bank

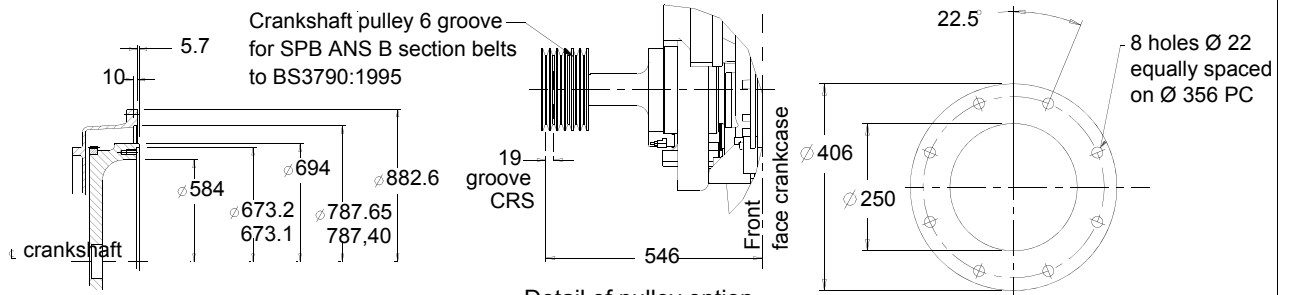
4016-61TRG1 - Rear view



4016-61TRG1 - Plan view



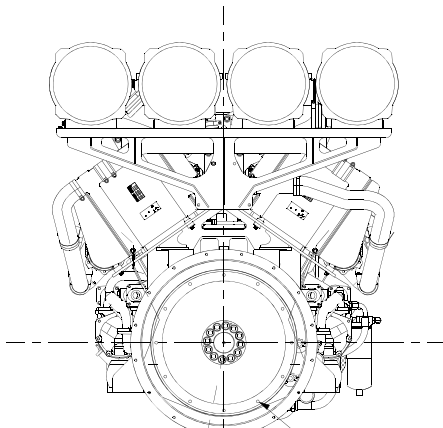
4016-61TRG1 - Accessories view



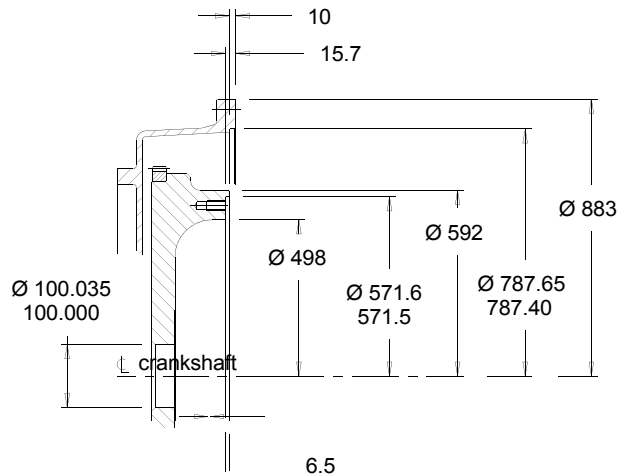
Detail of Sae J620 size 21 flywheel and SAE J617 No. 00 flywheel housing (metric tappings) scale 1:5

Detail of pulley option scale 1:5

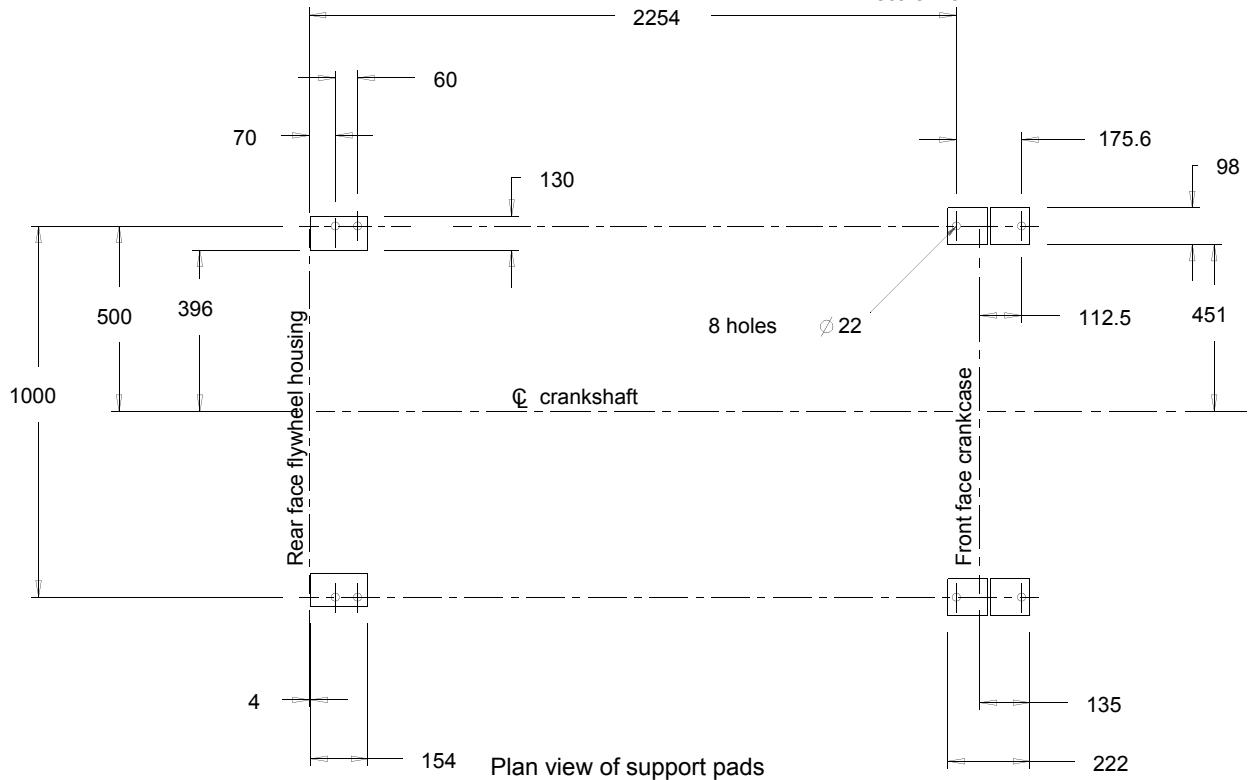
Detail of exhaust outlet flange (B.S.10 table D) scale 1:5



Optional 21" flywheel
16 holes M12 x 21 deep equally space as shown on \varnothing 851(3.5") PC
12 holes M16 x 30 deep equally spaced on \varnothing 641.35 (25.25" C)
11.25°



Detail of SAE J620 size 18 flywheel and SAE J617 No. 00 flywheel housing (metric tappings) see sheet 3 for 21" flywheel scale 1:5



Plan view of support pads

Typical load acceptance

Initial load application - when engine reaches rated speed (15 seconds max after engine starts to crank)				2nd load step after speed recovery			
Prime Power %	load kWm nett/ kWe	Transient frequency deviation %	Frequency recovery time seconds	Prime Power %	load kWm/kWe	Transient frequency deviation %	Frequency recovery time seconds
4016-61TRG1							
63	985/936	≤ -10	5	37	573/544	≤ -10	5
4016-61TRG2							
58.5	985/936	≤ -10	5	41.5	700/644	≤ -10	5
4016-61TRG3							
52	985/936	≤ -10	5	48	900/864	≤ -10	5

The figure shown in the tables above were obtained under the following test conditions

Engine block temperature (cold)45°C
 Ambient temperature25°C
 Governing mode Isochronous
 Alternator inertia 55 kgm
 Under frequency roll off (UFRO) point set to49.5 Hz
 UFRO rate set to 16 V/Hz
 LAM on /off. On

All tests were conducted using an engine installed and serviced to Perkins Engine Company limited recommendations.

Noise levels

The figures for total noise levels are typical for an engine running at the continuous baseload power rating in a semi-reverberant environment and measured at a distance of one metre from the periphery of the engine (sound pressure level re: -20×10^{-6} pa).

Ambient noise level 78 dBA

Octave analysis

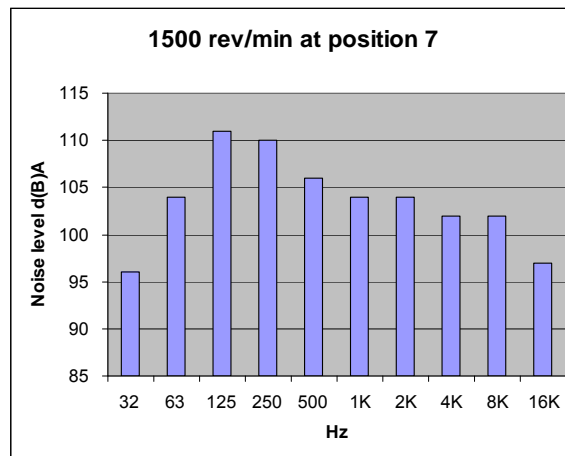
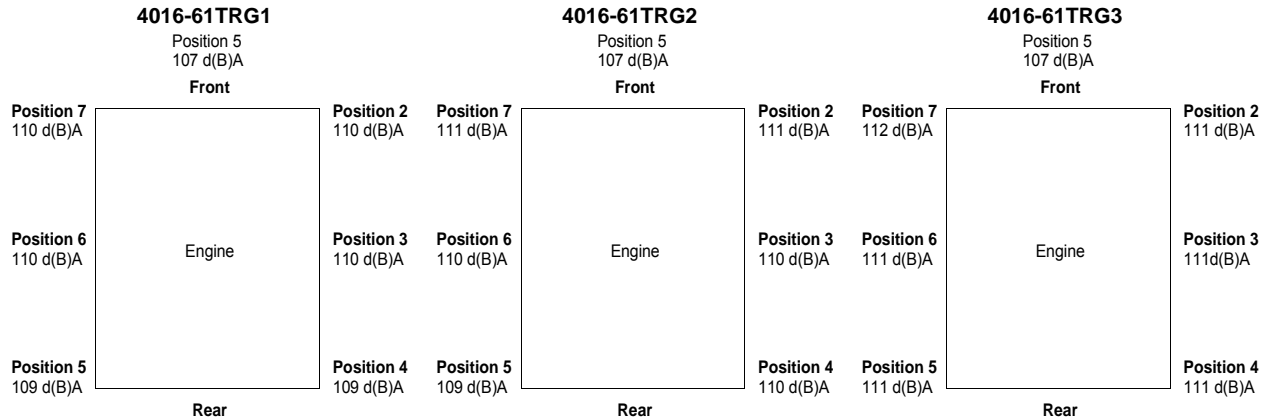
The following histograms show an octave band analysis at the position of the maximum noise.

Total noise level

Sound pressure level re: -20×10^{-6}

Speed 1500 rev/min ambient noise level 75 d(B)A

Octave analysis performed at the position of maximum noise.



The information given on this Technical Data Sheet is for guidance only. For ratings other than those shown, please contact Perkins Engines Company Limited.

@ Perkins®

Perkins Engines Company Limited
Peterborough PE1 5NA United Kingdom
Telephone +44 (0) 1733 583000
Fax +44 (0) 1733 582240
www.perkins.com

All information in the document is substantially correct at the time of printing but may be subsequently altered by the company.

Distributed by

