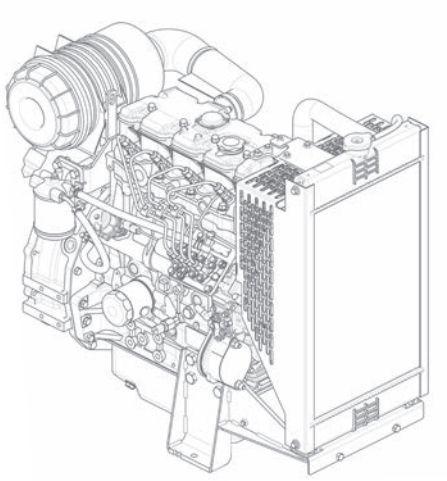
400 Series 404A-22G1 ElectropaK

20.3 kWm @ 1500 rpm

The Perkins® 400 Series engine family continues to set new standards in the compact engine market. Developed alongside customers to fulfill their needs in the generator set, compressor, agricultural and general industrial markets.

These new ElectropaKs provide compact power, from a robust family of 3 and 4 cylinder diesel engines designed to provide economic and durable operation at prime and standby duties, hitting the key power nodes required by the power generation industry.



Powered by your needs

- The 404A-22G1 ElectropaK is a powerful but quiet 2.2 litre naturally aspirated 4-cylinder compact package

Compact, clean, efficient power

- Design features on the 400D range of ElectropaKs ensures clean rapid starting in all conditions whilst delivering impressive performance with low operating costs in a small, efficient package size

Lower operating costs

- Approved for operation on biodiesel* concentrations of up to 20%
- Oil and filter changes are 500 hours, dependent on load factor
- Engine durability and reliability, the warranty offering and ease of installation combine to drive down the cost of ownership

Product support

- With highly trained Perkins distributors in thousands of communities in over 180 countries, you are never far away from expert product knowledge, genuine parts and a range of advanced diagnostic technology for keeping your engine in peak condition

Warranties and Service Contracts

We provide one-year warranties for constant speed engines and two-year warranties for variable speed models, as standard. These are supported by multilevel Extended Service Contracts that can be bought additionally

Discover more
www.perkins.com
www.perkins.com/esc

www.perkins.com/distributor
To find your local distributor

Engine speed	Type of Operation	Typical Generator Output (Net)		Engine Power				Low Idle
				Gross		Net		
		kVA	kWe	kWm	hp	kWm	hp	
1500	Prime power	20.3	16.2	18.7	25.1	18.4	24.7	n/a
	Standby power	22.3	17.8	20.6	27.6	20.3	27.2	n/a

*Subject to conformance with ASTM D6751 and EN14214.

The above ratings represent the engine performance capabilities to conditions specified in ISO 8528/1, ISO 3046/1:1986, BS 5514/1. **Derating may be required for conditions outside these; consult Perkins Engines Company Limited.** Generator powers are typical and are based on typical alternator efficiencies and a power factor (cos θ of 0.8.

Fuel specification: BS 2869: Part 2 1998 Class A2 or ASTM D975 D2.

Rating Definitions: Prime Power: Power available at variable load in lieu of a main power network. Overload of 10% is permitted for 1 hour in every 12 hours operation. **Standby (maximum):** Power available at variable load in the event of a main power network failure. No overload is permitted.

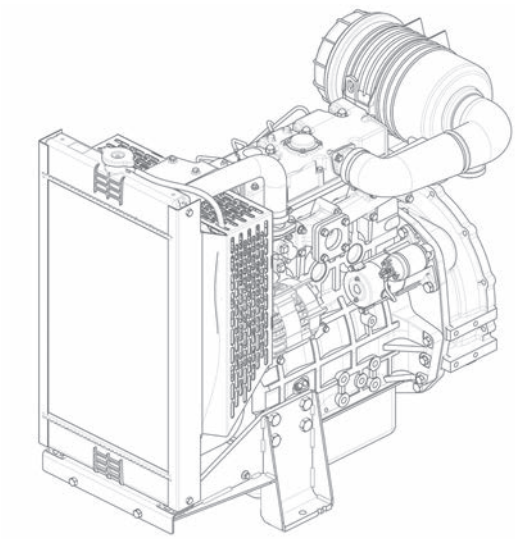
Photographs are for illustrative purposes only and may not reflect final specification.

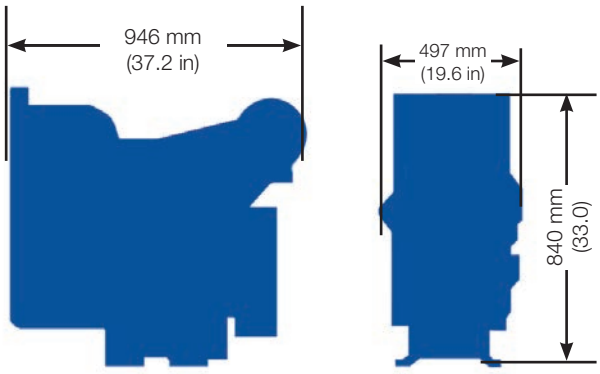
Perkins®
THE HEART OF EVERY GREAT MACHINE

400 Series 404A-22G1

ElectropaK

20.3 kWm @ 1500 rpm





Fuel Consumption		
Engine Speed	1500 rpm	
	g/kWh	l/hr
Standby	244	6.1
Prime power	237	5.3
75% of prime power	238	4.0
50% of prime power	258	2.9

Standard electropaK specification

Air inlet
- Mounted air filter

Fuel system
- Mechanically governed cassette type fuel injection pump
- Split element fuel filter

Lubrication system
- Wet steel sump with filler and dipstick
- Spin-on full-flow lub oil filter

Cooling system
- Thermostatically-controlled system with belt driven coolant pump and pusher fan
- Mounted radiator, piping and guards

Electrical equipment
- 12 volt starter motor and 12 volt 15 amp alternator with DC output
- Oil pressure and coolant temperature switches
- 12 volt shut-off solenoid energised to run
- Glow plug cold start aid and heater/starter switch

Flywheel and housing
- 1500 rpm
- High inertia flywheel to SAE J620 Size 190.5 mm (7½ in) Heavy
- Flywheel housing SAE 4 Long

Mountings
- Front and rear engine mounting bracket

General Data

Number of cylinders 4
Cylinder arrangement ..... Vertical in-line
Cycle ..... 4 stroke
Aspiration ..... Naturally aspirated
Combustion system ..... Indirect injection
Compression ratio 23.3:1
Bore and Stroke ..... 84 x 100 mm (3.3 x 3.9 in)
Displacement ..... 2.216 litres (135.2 cubic in)
Direction of rotation ..... Anti-clockwise viewed on flywheel
Cooling system ..... Water cooled
Total coolant capacity ..... 7.0 litres (1.8 US gals)
Total lubrication system capacity ..... 10.6 litres (2.8 US gals)
Dimensions
- Length ..... 946 mm (37.2 in)
- Width ..... 497 mm (19.6 in)
- Height ..... 840 mm (33.0 in)

Total weight (dry) ..... 242 kg (533 lb)

Final weight and dimensions will depend on completed specification.

Optional equipment
- Parts book

Option groups
A selection of optional items is available to enable you to prepare a specification precisely matched to your needs.

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Perkins®
THE HEART OF EVERY GREAT MACHINE

mecc alte spa

GENERATOR TYPE ECO 28-2LN/4

Document : **DS003A/1**

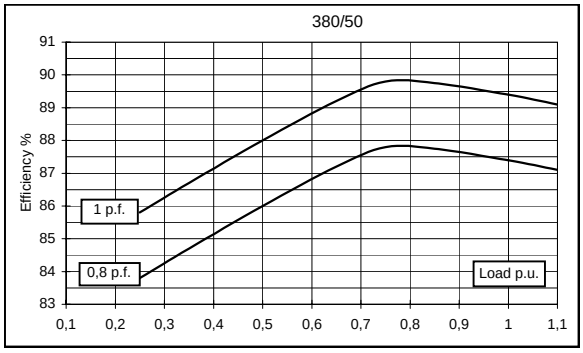
issue 008 date 10/05/2006

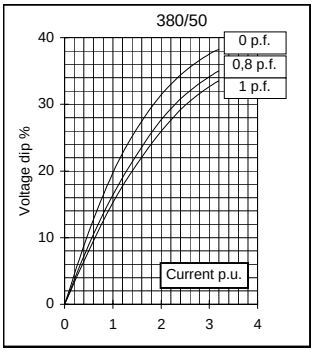
Electrical Characteristics										
Frequency		Hz	50				60			
Voltage (series star)		V	380	400	415	440	415	440	460	480
Rated power class H		kVA	25	25	25	-	26	27,5	30	30
		kW	20	20	20	-	20,8	22	24	24
Rated power class F		kVA	23	23	23	-	24	25,5	27,5	27,5
		kW	18,4	18,4	18,4	-	19,2	20,4	22	22
Regulation with		SR7/2	±1,5 % with any power factor and speed variations between -5% +30%							
Insulation class			H							
Execution			Brushless							
Stator winding			12 ends							
Rotor			without damping cage							
Efficiencies class H	4/4	%	87,4	87,8	88,1	-	88,8	89,1	89,3	89,7
(see graph. for details)	3/4	%	87,8	88,1	88,2	-	89,4	89,6	89,8	90
	2/4	%	86	86,1	86,1	-	87,7	87,8	87,9	88
	1/4	%	83,8	83,6	83,6	-	85,9	85,7	85,9	85,8
Reactances (f. l.cl. F)	Xd	%	205,0	185	171,9	-	214,5	201,8	201,4	185
	Xd'	%	17,95	16,2	15,05	-	18,78	17,67	17,64	16,2
	Xd''	%	10,19	9,2	8,55	-	10,67	10,04	10,02	9,2
	Xq	%	84,2	76	70,6	-	88,1	82,9	82,8	76
	Xq'	%	84,2	76	70,6	-	88,1	82,9	82,8	76
	Xq''	%	23,3	21	19,5	-	24,3	22,9	22,9	21
	X_2	%	15,18	13,7	12,73	-	15,88	14,95	14,92	13,7
	X_0	%	3,43	3,1	2,88	-	3,59	3,38	3,38	3,1
Short Circuit Ratio	Kcc		0,50	0,58	0,80	-	0,38	0,43	0,50	0,58
Time Constants	Td'	sec.	0,047							
	Td''	sec.	0,013							
	Tdo'	sec.	0,93							
	$T\alpha$	sec.	0,011							
Short Circuit Current Capacity		%	>300				>350			
Excitation at no load		Amp.	0,45	0,6	0,7	-	0,3	0,4	0,5	0,55
Excitation at full load		Amp.	1,4	1,6	1,8	-	1,3	1,4	1,5	1,6
Overload (long-term)		%	1 hour in a 6 hours period 110% rated load							
Overload per 20 sec.		%	300							
Stator Winding Resistance (20°C)		Ω	0,128							
Rotor Winding Resistance (20°C)		Ω	1,67							
Exciter Resistance (20 °C)		Ω	Rotor : 0,417				Stator : 10,60			
Heat dissipation at f.l.cl.H		W	2883	2779	2701	-	2623	2691	2876	2756
Telephone Interference			FHT < 2%				TIF < 45			
Radio interference			EN60034-1. For others standards apply to factory							
Waveform Distors.(THD) at f. load		LL/LN %	2 / 2							
Waveform Distors.(THD) at no load		LL/LN %	3,4 / 3,2							
Mechanical characteristics										
Protection			IP 23 (other protection on request)							
DE bearing			6309-2RS							
NDE bearing			6209-2RS							
Weight of wound stator assembly		kg	50							
Weight of wound rotor assembly		kg	27							
Weight of complete generator		kg	139							
Maximun overspeed		rpm	2250							
Unbalanced magnetic pull at f.l.cl.F		kN/mm	4,5							
Cooling air requirement		m^3/min	5,3				5,8			
Inertia Constant (H)		sec.	0,082				0,099			
Noise level at 1m/7m		dB(A)	68 / 57				71 / 61			

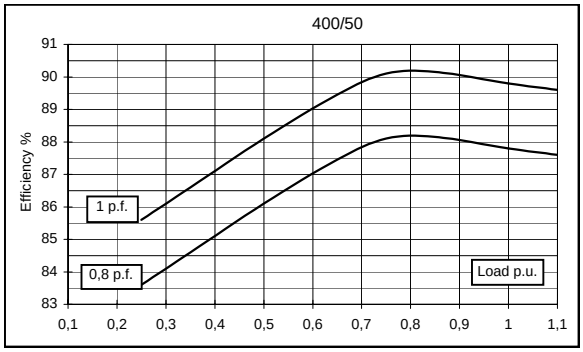
GENERATOR TYPE ECO 28-2LN/4

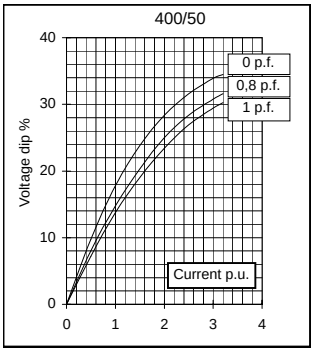
Document : **DS003A/2**
issue 007 date : 10/05/06

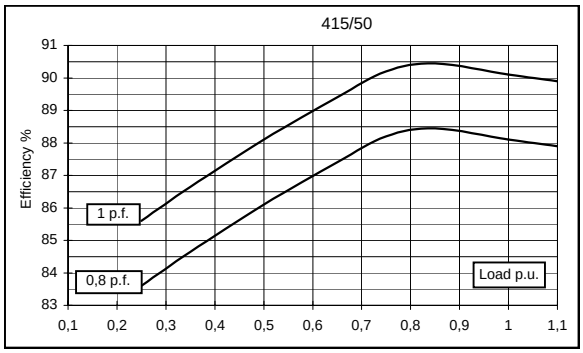
50 Hz

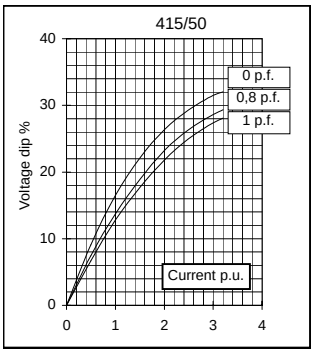


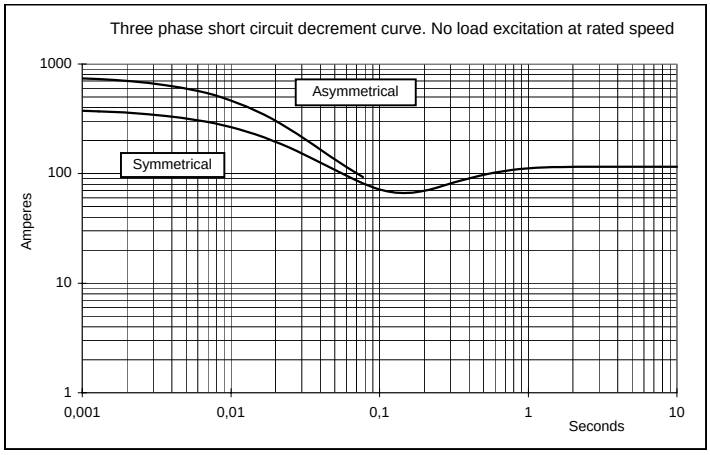




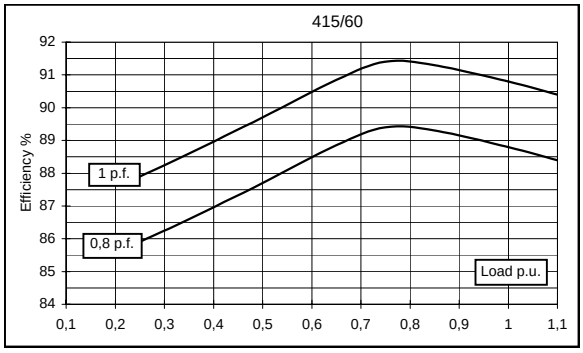


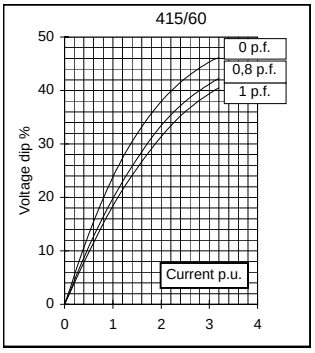


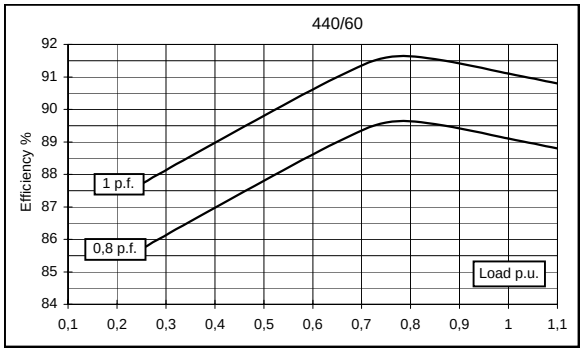


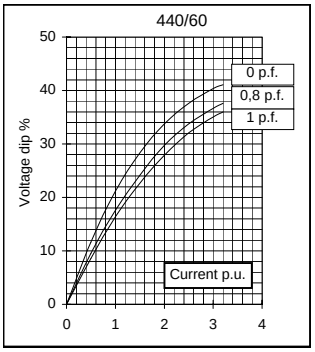


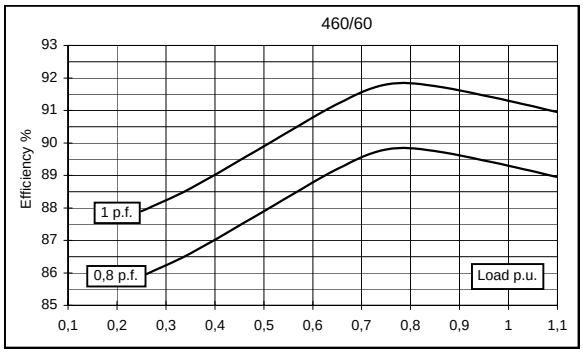
60 Hz

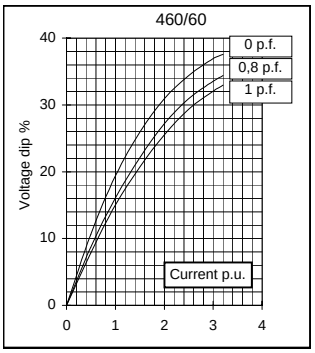


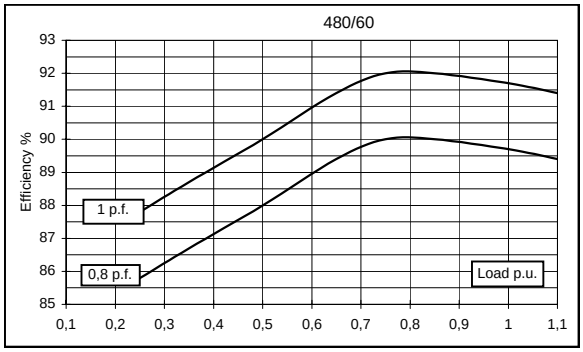


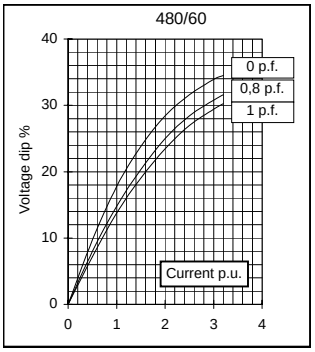


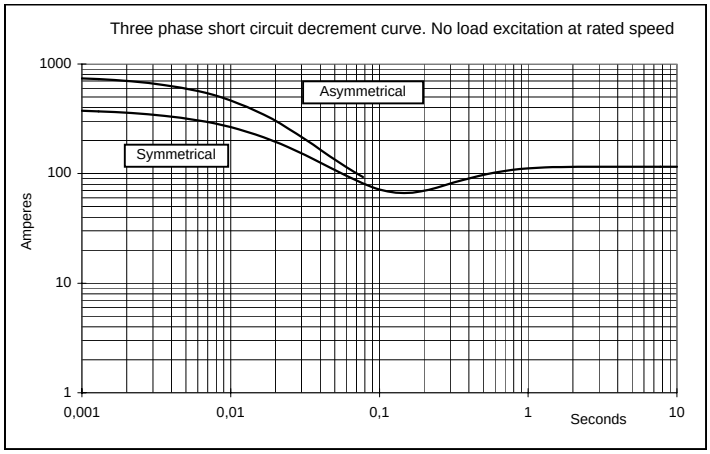




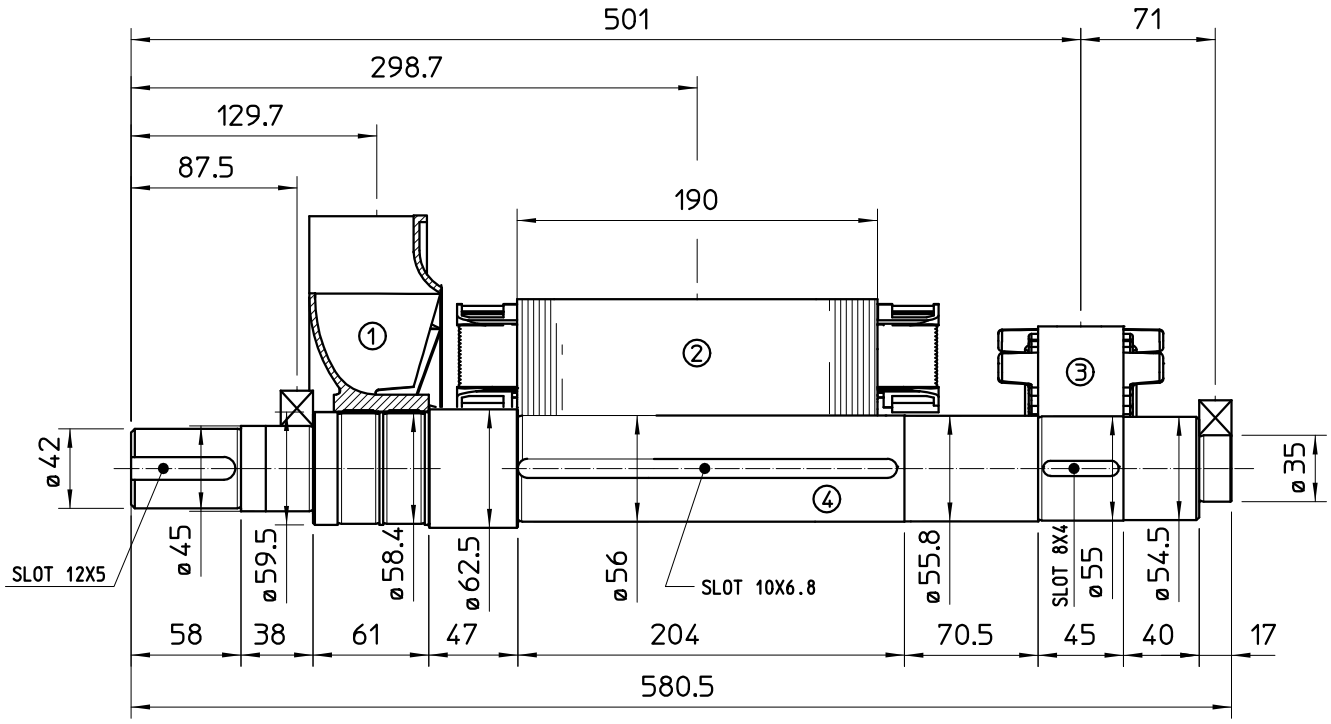






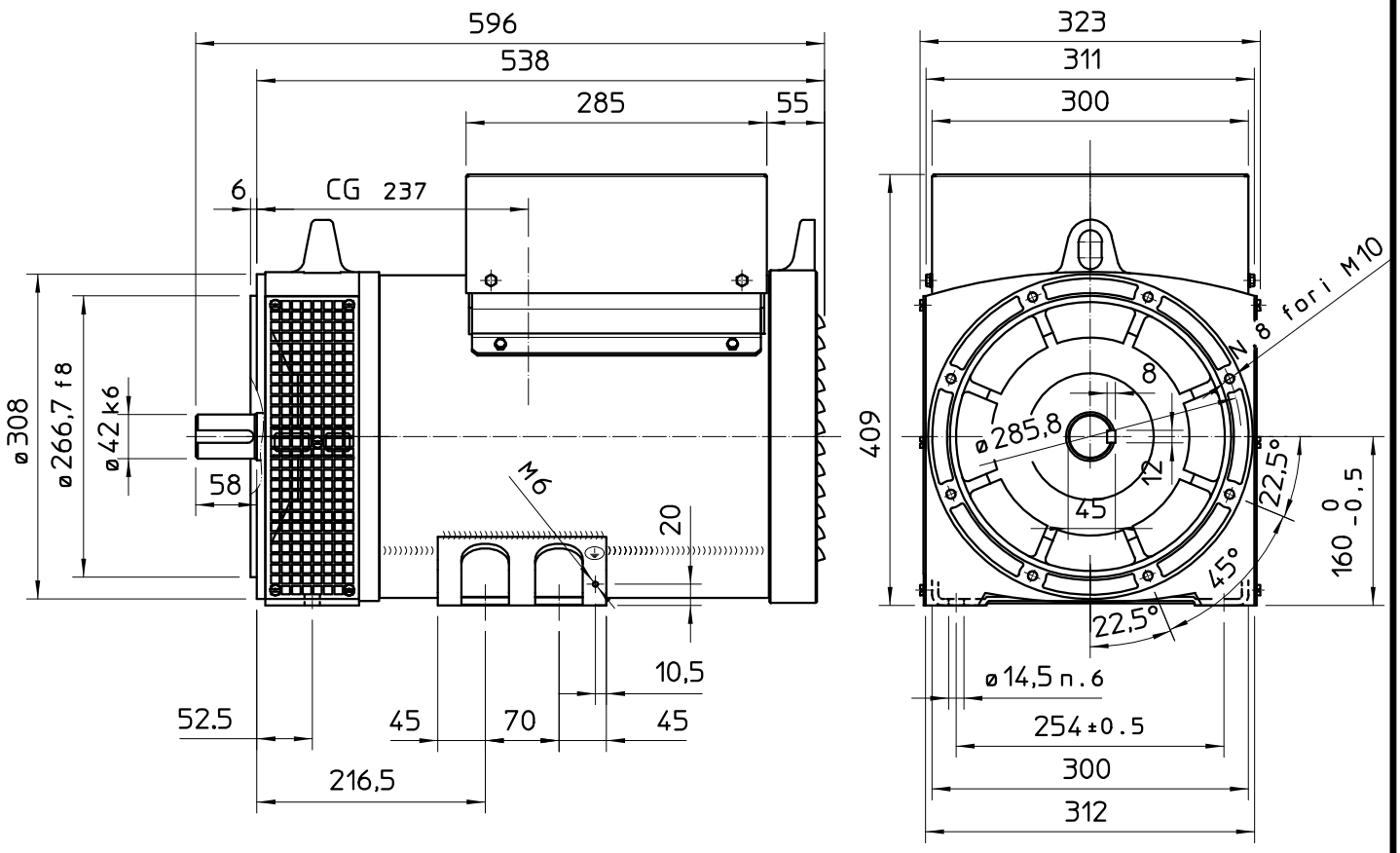


TWO BEARING MOMENTS OF INERTIA



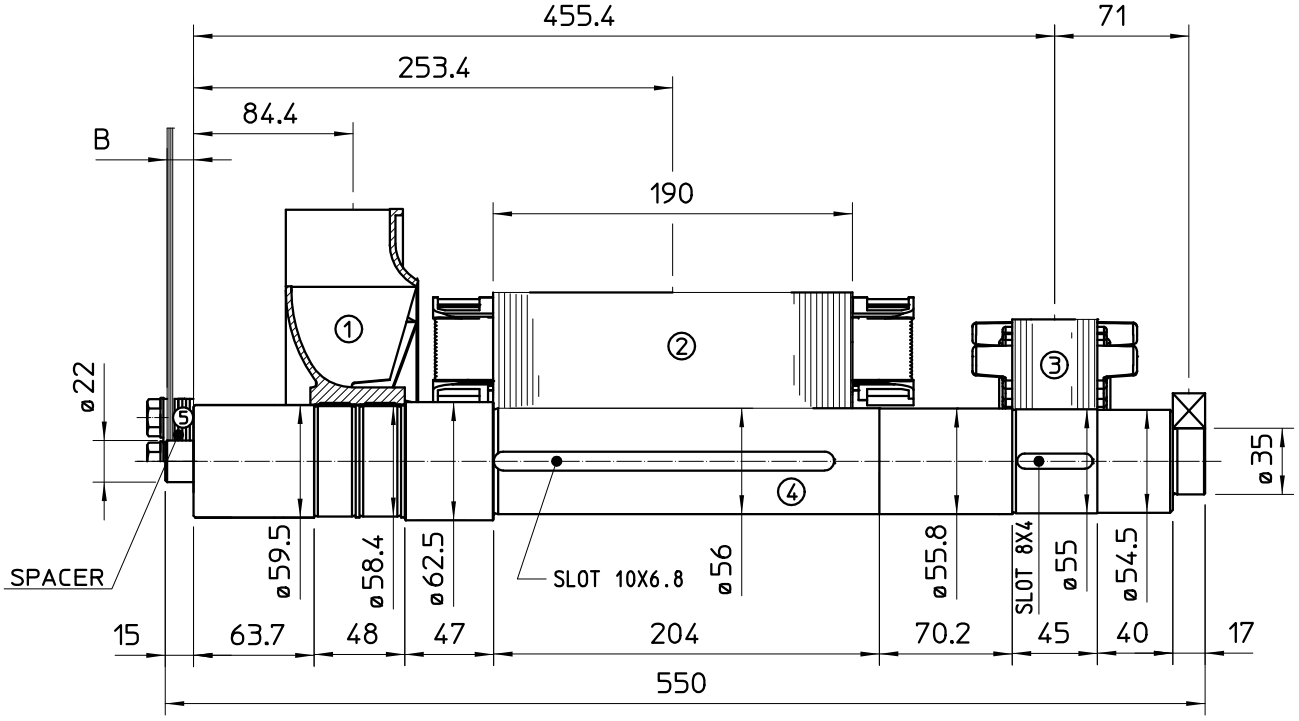
	COMPONENT	WEIGHT Kg	J Kgm²
1	FAN	1.2	0.0102
2	MAIN ROTOR	26.8	0.117
3	EX ROTOR	5.4	0.012
4	SHAFT	10.6	0.004
6	TOTAL	44	0.1432

TWO BEARING DIMENSIONS



C.G. = GRAVITY CENTER

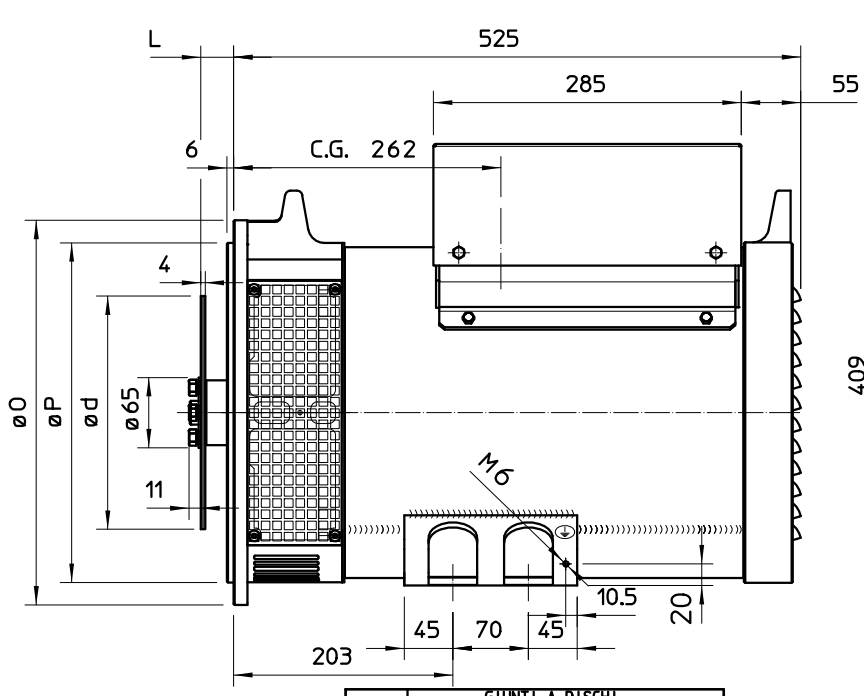
SINGLE BEARING MOMENTS OF INERTIA

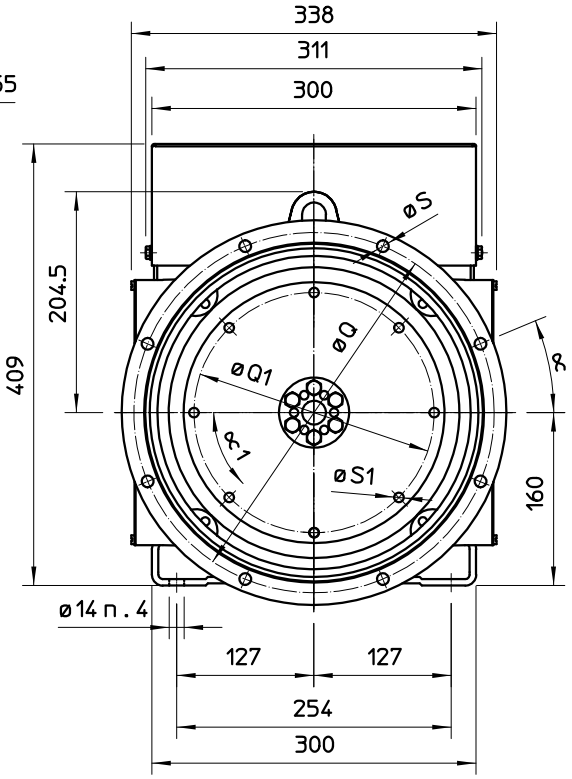


	COMPONENT	WEIGHT Kg	J Kgm²
1	FAN	1.2	0.0102
2	MAIN ROTOR	26.8	0.117
3	EX ROTOR	5.4	0.012
4	SHAFT	10.5	0.0041
6	TOTAL	43.9	0.1433

SAE N.	5	SHAFT COUPLING FLEX PLATE	
	B(mm)	WEIGHT kg	J kgm²
6 1/2	4	1.14	0.0067
7 1/2	4	1.42	0.0103
8	35.6	1.97	0.0171
10	27.6	2.59	0.0319
11 1/2	14	3.1	0.0481

SINGLE BEARING DIMENSIONS





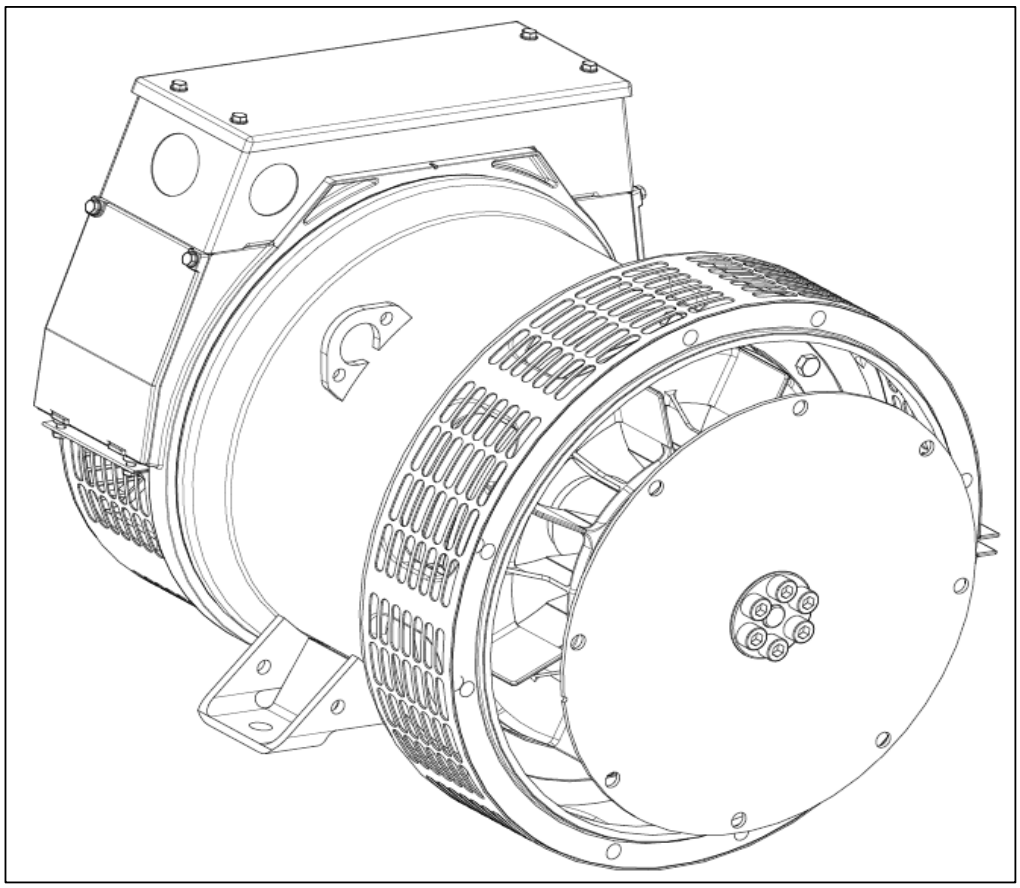
SAE N.	FLANGIA/FLANGE BRIDE/FLANSCH					
	O	P	Q	n. fori	S	α
5	356	314.3	333.4	8	11	22°30'
4	403	362	381	12	11	15°
3	451	409.6	428.6	12	11	15°
2	489	447.7	466.7	12	11	15°

SAE N.	GIUNTI A DISCHI DISC COUPLING DISQUE DE MONOPALIER SCHEIBENKUPPLUNG					
	L	d	Q1	n. fori	S1	α1
6 1/2	30.2	215.9	200	6	9	60°
7 1/2	30.2	241.3	222.25	8	9	45°
8	62	263.52	244.47	6	11	60°
10	53.8	314.32	295.27	8	11	45°
11 1/2	39.6	352.42	333.37	8	11	45°

C.G. = GRAVITY CENTER

STAMFORD®

PI144D - Technical Data Sheet



SPECIFICATIONS & OPTIONS

STANDARDS

Stamford industrial generators meet the requirements of BS EN 60034 and the relevant section of other international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC34, CSA C22.2-100, AS1359.
Other standards and certifications can be considered on request.

VOLTAGE REGULATOR

AS480 AVR fitted as STANDARD

With this self-excited system the main stator provides power via the AVR to the exciter stator. The high efficiency semi-conductors of the AVR ensure positive build-up from initial low levels of residual voltage.
The exciter rotor output is fed to the main rotor through a three-phase full-wave bridge rectifier. The rectifier is protected by a surge suppressor against surges caused, for example, by short circuit or out-of-phase paralleling. The AS480 will support limited accessories, RFI suppession remote voltage trimmer and for the P1 range only a 'droop' Current Transformer (CT) to permit parallel operation with other ac generators.
The AVR is can be fitted to either side of the generator in its own housing in the non-drive end bracket.

Excitation Boost System (EBS) (OPTIONAL)

The EBS is a single, self-contained unit, attached to the non-drive end of the generator.
The EBS unit consists of the Excitation Boost Controller (EBC) and an Excitation Boost Generator (EBG). Under fault conditions, or when the generator is subjected to a large impact load such as a motor starting, the generator voltage will drop. The EBC senses the drop in voltage and engages the output power of the EBG. This additional power feeds the generator's excitation system, supporting the load until breaker discrimination can remove the fault or enable the generator to pick up a motor and drive the voltage recovery.

WINDINGS & ELECTRICAL PERFORMANCE

All generator stators are wound to 2/3 pitch. This eliminates triplen (3rd, 9th, 15th …) harmonics on the voltage waveform and is found to be the optimum design for trouble-free supply of non-linear loads. The 2/3 pitch design avoids excessive neutral currents sometimes seen with higher winding pitches, when in parallel with the mains. A fully connected damper winding reduces oscillations during paralleling. This winding, with the 2/3 pitch and carefully selected pole and tooth designs, ensures very low waveform distortion.

TERMINALS & TERMINAL BOX

Standard generators are 3-phase reconnectable with 12 ends brought out to the terminals, which are mounted at the non-drive end of the generator. Dedicated single phase generators are also available. A sheet steel terminal box contains provides ample space for the customers' wiring and gland arrangements. Alternative terminal boxes are available for customers who want to fit additional components in the terminal box.

SHAFT & KEYS

All generator rotors are dynamically balanced to better than BS6861:Part 1 Grade 2.5 for minimum vibration in operation. Two bearing generators are balanced with a half key.

INSULATION / IMPREGNATION

The insulation system is class 'H'.
All wound components are impregnated with materials and processes designed specifically to provide the high build required for static windings and the high mechanical strength required for rotating components.

QUALITY ASSURANCE

Generators are manufactured using production procedures having a quality assurance level to BS EN ISO 9001.

The stated voltage regulation may not be maintained in the presence of certain radio transmitted signals. Any change in performance will fall within the limits of Criteria 'B' of EN 61000-6-2:2001. At no time will the steady-state voltage regulation exceed 2%.

NB Continuous development of our products entitles us to change specification details without notice, therefore they must not be regarded as binding.

Front cover drawing typical of product range.

WINDING 311

CONTROL SYSTEM	STANDARD AS480 AVR (SELF EXCITED)
VOLTAGE REGULATION	± 1.0 %
SUSTAINED SHORT CIRCUIT	SELF EXCITED MACHINES DO NOT SUSTAIN A SHORT CIRCUIT CURRENT

CONTROL SYSTEM	AS480 AVR WITH OPTIONAL EXCITATION BOOST SYSTEM (EBS)
SUSTAINED SHORT CIRCUIT	REFER TO SHORT CIRCUIT DECREMENT CURVE (page 7)

STATOR WINDING	DOUBLE LAYER CONCENTRIC							
WINDING PITCH	TWO THIRDS							
WINDING LEADS	12							
STATOR WDG. RESISTANCE	0.353 Ohms PER PHASE AT 22°C SERIES STAR CONNECTED							
ROTOR WDG. RESISTANCE	0.657 Ohms at 22°C							
EXCITER STATOR RESISTANCE	18.5 Ohms at 22°C							
EXCITER ROTOR RESISTANCE	0.228 Ohms PER PHASE AT 22°C							
EBS STATOR RESISTANCE	12.9 Ohms at 22°C							
R.F.I. SUPPRESSION	BS EN 61000-6-2 & BS EN 61000-6-4,VDE 0875G, VDE 0875N. refer to factory for others							
WAVEFORM DISTORTION	NO LOAD < 1.5% NON-DISTORTING BALANCED LINEAR LOAD < 5.0%							
MAXIMUM OVERSPEED	2250 Rev/Min							
BEARING DRIVE END	BALL. 6309 - 2RS. (ISO)							
BEARING NON-DRIVE END	BALL. 6306 - 2RS. (ISO)							
	1 BEARING				2 BEARING			
WEIGHT COMP. GENERATOR	120.5 kg				123.5 kg			
WEIGHT WOUND STATOR	44 kg				44 kg			
WEIGHT WOUND ROTOR	41.87 kg				42.87 kg			
WR² INERTIA	0.1560 kgm^2				0.1561 kgm^2			
SHIPPING WEIGHTS in a crate	138 kg				147 kg			
PACKING CRATE SIZE	71 x 51 x 67 (cm)				71 x 51 x 67 (cm)			
	50 Hz				60 Hz			
TELEPHONE INTERFERENCE	THF<2%				TIF<50			
COOLING AIR	0.09 m³/sec 191cfm				0.108 m³/sec 229 cfm			
VOLTAGE SERIES STAR	380/220	400/231	415/240	440/254	416/240	440/254	460/266	480/277
VOLTAGE PARALLEL STAR	190/110	200/115	208/120	220/127	208/120	220/127	230/133	240/138
VOLTAGE SERIES DELTA	220/110	230/115	240/120	254/127	240/120	254/127	266/133	277/138
kVA BASE RATING FOR REACTANCE VALUES	20	20	20	19	22	23.5	24.3	25
Xd DIR. AXIS SYNCHRONOUS	1.66	1.50	1.39	1.18	1.97	1.88	1.78	1.68
X'd DIR. AXIS TRANSIENT	0.17	0.15	0.14	0.12	0.20	0.19	0.18	0.17
X"d DIR. AXIS SUBTRANSIENT	0.11	0.10	0.09	0.08	0.13	0.12	0.12	0.11
Xq QUAD. AXIS REACTANCE	0.80	0.72	0.67	0.57	0.95	0.91	0.86	0.81
X"q QUAD. AXIS SUBTRANSIENT	0.18	0.16	0.15	0.13	0.21	0.20	0.19	0.18
X_L LEAKAGE REACTANCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
X_2 NEGATIVE SEQUENCE	0.14	0.13	0.12	0.10	0.17	0.16	0.15	0.15
X_0 ZERO SEQUENCE	0.07	0.06	0.06	0.05	0.08	0.08	0.07	0.07
REACTANCES ARE SATURATED	VALUES ARE PER UNIT AT RATING AND VOLTAGE INDICATED							
T'd TRANSIENT TIME CONST.	0.017 s							
T"d SUB-TRANSTIME CONST.	0.004 s							
T'do O.C. FIELD TIME CONST.	0.38 s							
Ta ARMATURE TIME CONST.	0.007 s							
SHORT CIRCUIT RATIO	1/Xd							

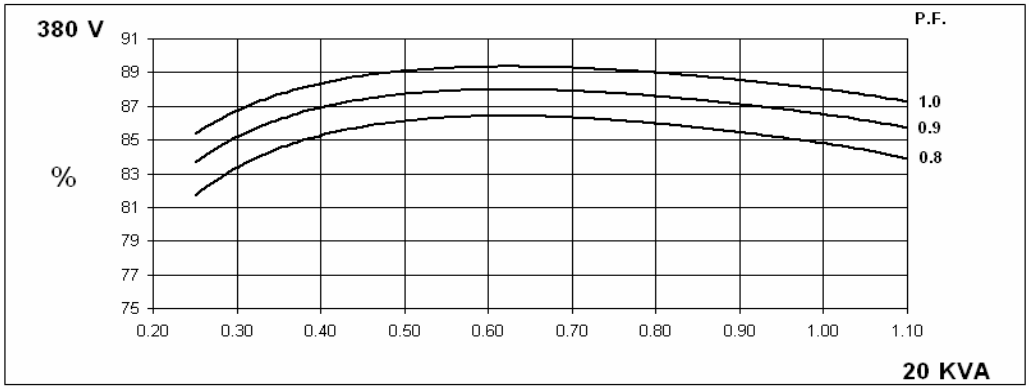
50 Hz

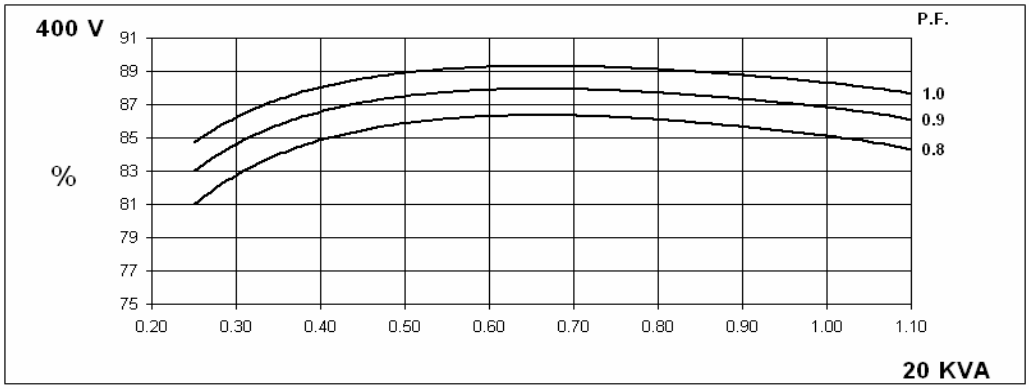
PI144D

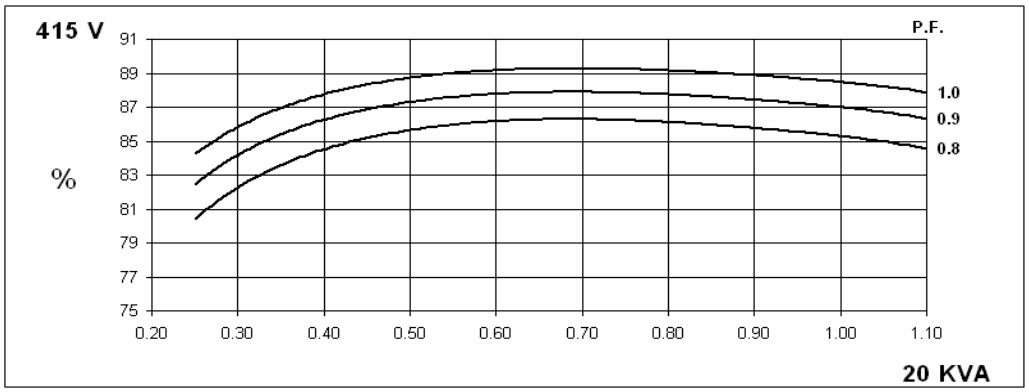
Winding 311

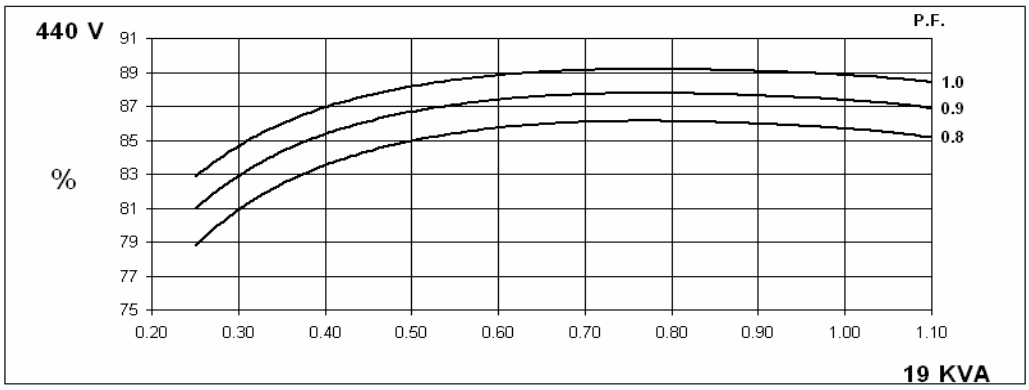
STAMFORD

THREE PHASE EFFICIENCY CURVES









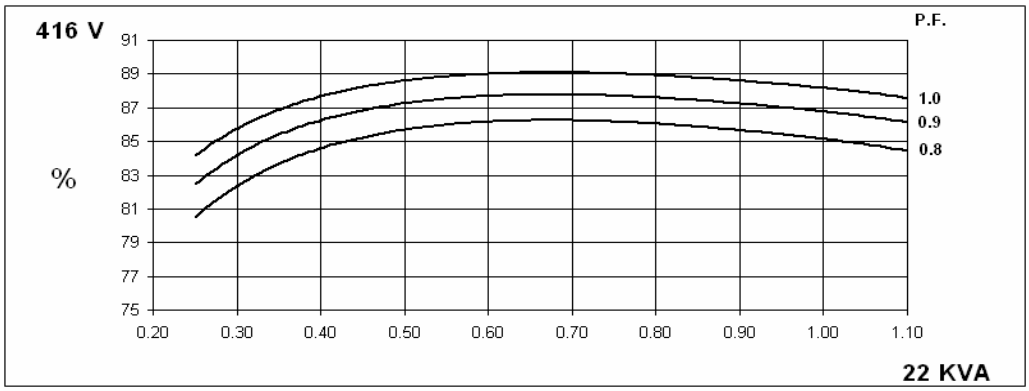
60 Hz

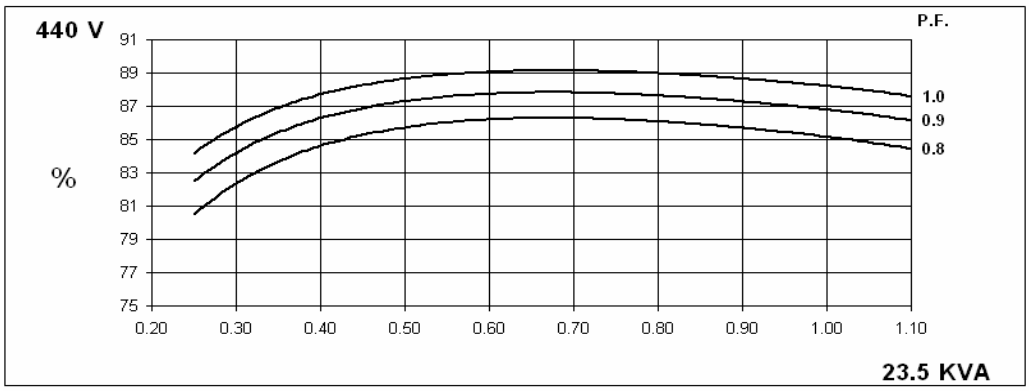
PI144D

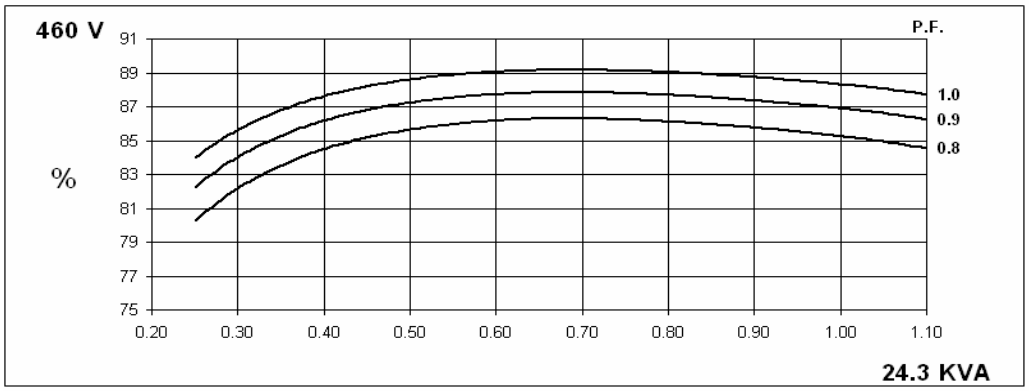
Winding 311

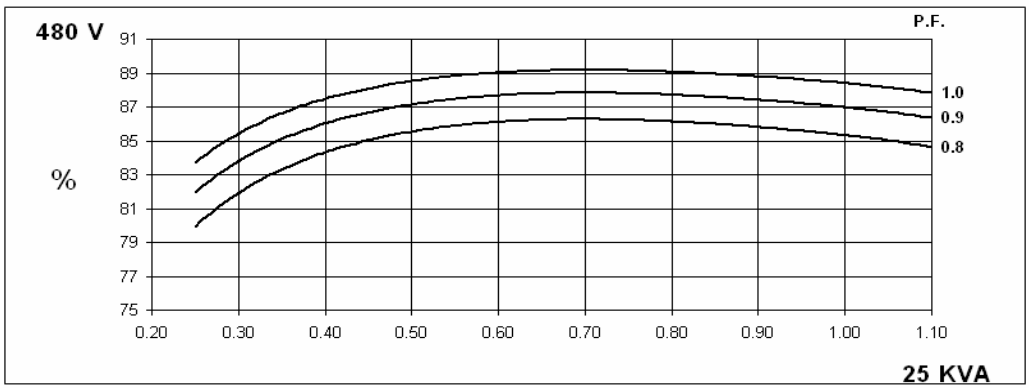
STAMFORD

THREE PHASE EFFICIENCY CURVES



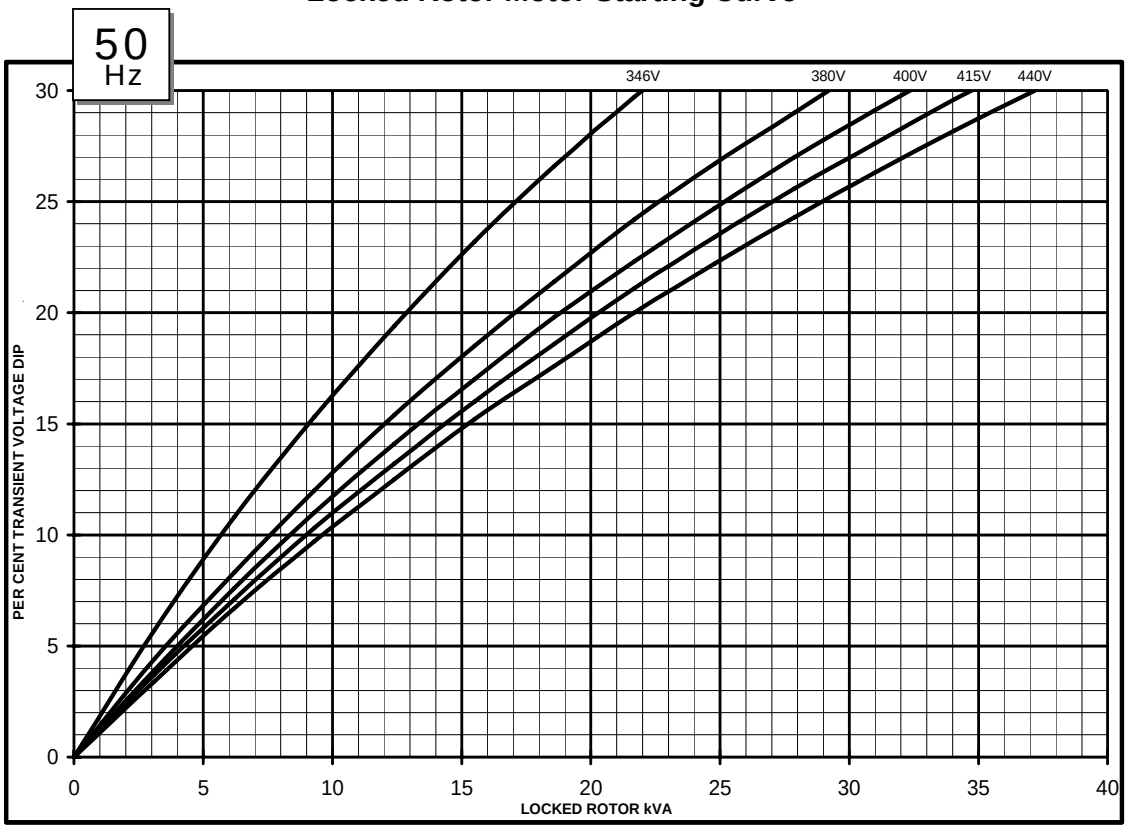


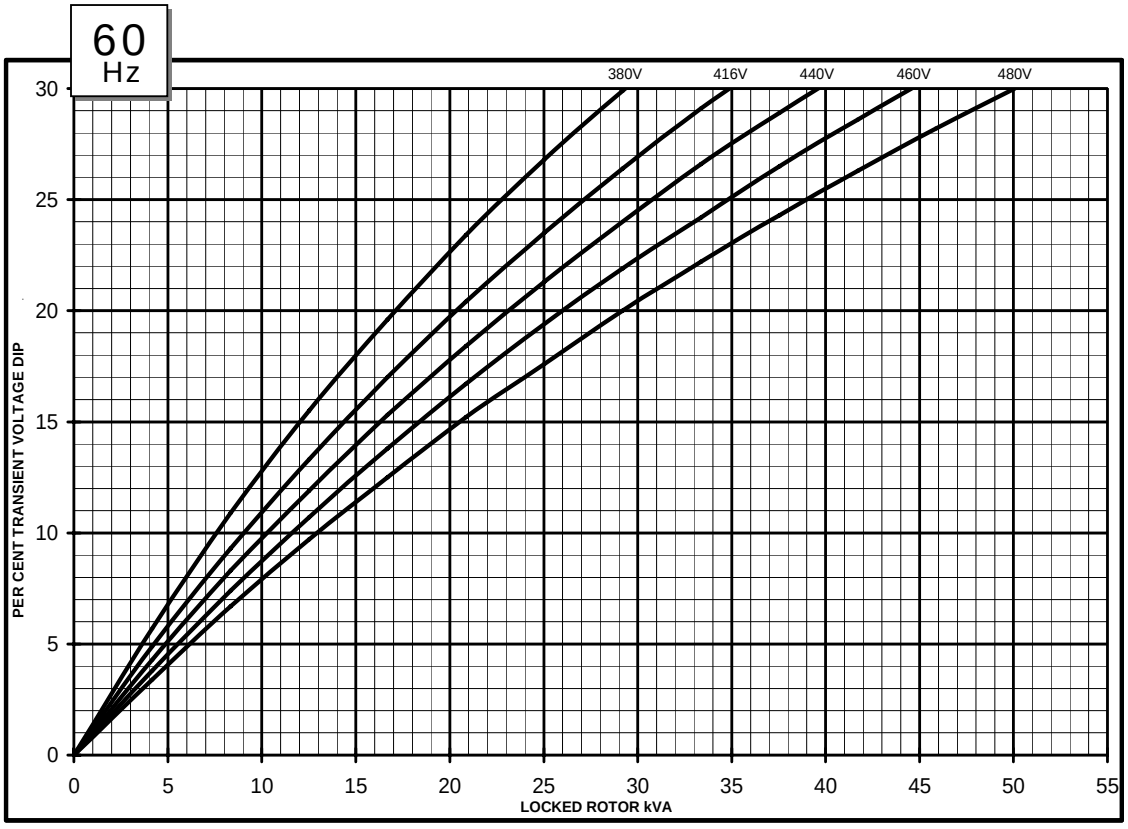




Winding 311

Locked Rotor Motor Starting Curve





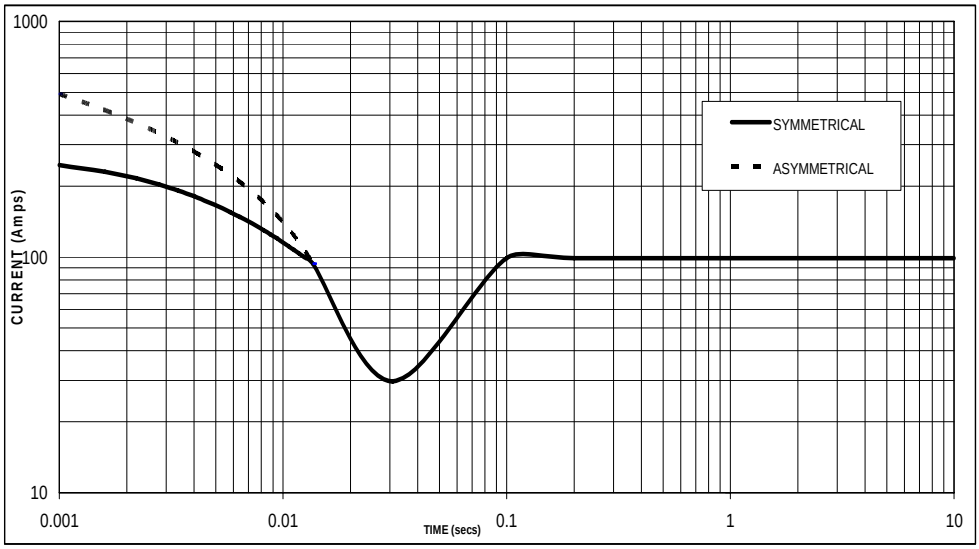
PI144D

WITH EBS FITTED

Three-phase Short Circuit Decrement Curve. No-load Excitation at Rated Speed

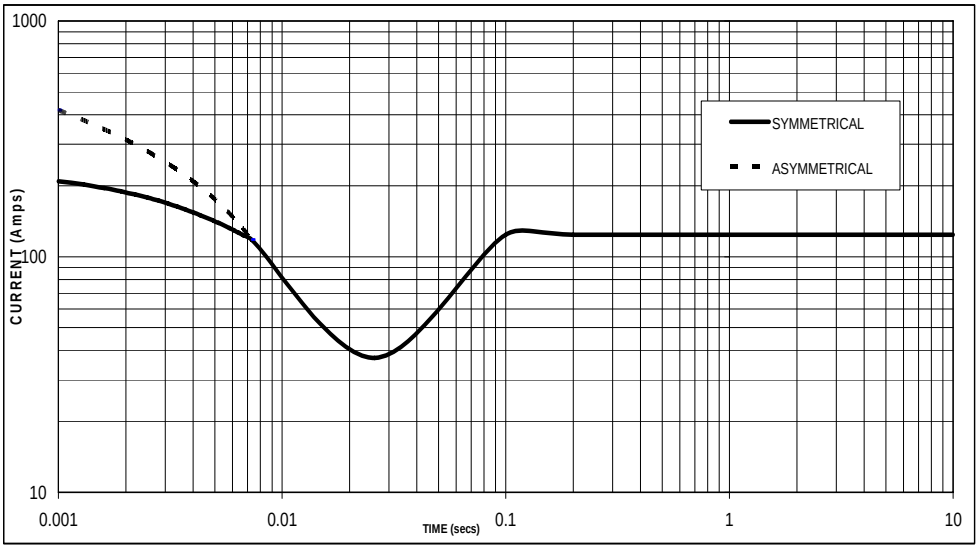
Based on star (wye) connection.

50 Hz



Sustained Short Circuit = 99 Amps

60 Hz



Sustained Short Circuit = 124 Amps

Note 1

The following multiplication factors should be used to adjust the values from curve between time 0.001 seconds and the minimum current point in respect of nominal operating voltage :

50Hz		60Hz	
Voltage	Factor	Voltage	Factor
380v	X 1.00	416v	X 1.00
400v	X 1.05	440v	X 1.06
415v	X 1.09	460v	X 1.10
440v	X 1.16	480v	X 1.15

The sustained current value is constant irrespective of voltage level

Note 2

The following multiplication factor should be used to convert the values calculated in accordance with NOTE 1 to those applicable to the various types of short circuit :

	3-phase	2-phase L-L	1-phase L-N
Instantaneous	x 1.00	x 0.87	x 1.30
Minimum	x 1.00	x 1.80	x 3.20
Sustained	x 1.00	x 1.50	x 2.50
Max. sustained duration	10 sec.	5 sec.	2 sec.

All other times are unchanged

Note 3

Curves are drawn for Star (Wye) connected machines. For other connection the following multipliers should be applied to current values as shown :

Parallel Star = Curve current value X 2

Series Delta = Curve current value X 1.732

PI144D

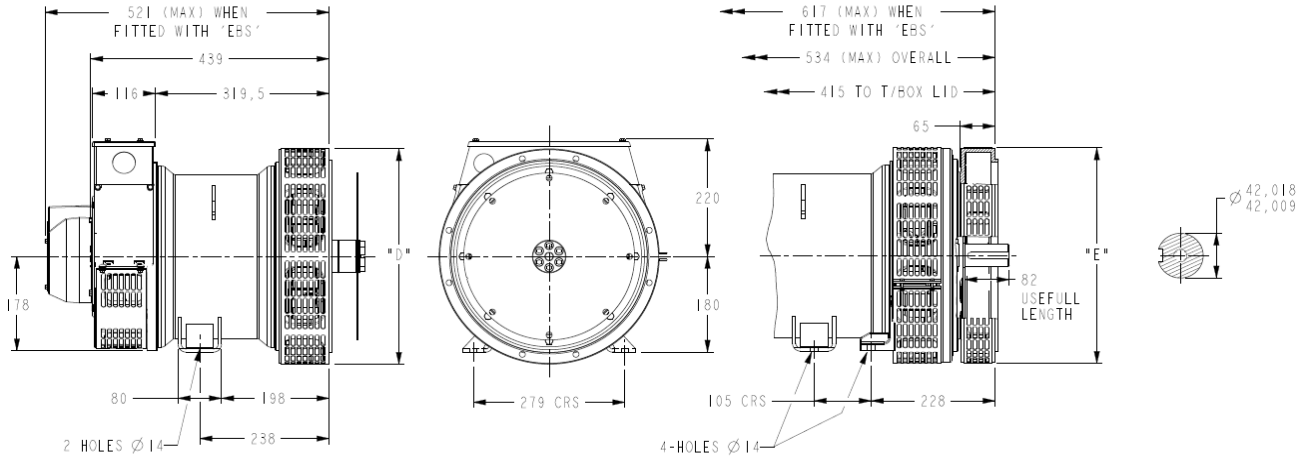
Winding 311 / 0.8 Power Factor

RATINGS

	Class - Temp Rise	Cont. F - 105/40°C				Cont. H - 125/40°C				Standby - 150/40°C				Standby - 163/27°C			
50 Hz	Series Star (V)	380	400	415	440	380	400	415	440	380	400	415	440	380	400	415	440
	Parallel Star (V)	190	200	208	220	190	200	208	220	190	200	208	220	190	200	208	220
	Series Delta (V)	220	230	240	254	220	230	240	254	220	230	240	254	220	230	240	254
	kVA	18.2	18.2	18.2	17.3	20.0	20.0	20.0	19.0	21.5	21.5	21.5	20.4	22.0	22.0	22.0	20.9
	kW	14.6	14.6	14.6	13.8	16.0	16.0	16.0	15.2	17.2	17.2	17.2	16.3	17.6	17.6	17.6	16.7
	Efficiency (%)	85.4	85.7	85.8	86.0	84.8	85.1	85.3	85.7	84.2	84.6	84.8	85.4	84.0	84.4	84.6	85.2
	kW Input	17.0	17.0	17.0	16.1	18.9	18.8	18.8	17.7	20.4	20.3	20.3	19.1	21.0	20.9	20.8	19.6

60 Hz	Series Star (V)	416	440	460	480	416	440	460	480	416	440	460	480	416	440	460	480
	Parallel Star (V)	208	220	230	240	208	220	230	240	208	220	230	240	208	220	230	240
	Delta (V)	240	254	266	277	240	254	266	277	240	254	266	277	240	254	266	277
	kVA	20.0	21.4	22.1	22.8	22.0	23.5	24.3	25.0	23.7	25.3	26.1	26.9	24.2	25.9	26.7	27.5
	kW	16.0	17.1	17.7	18.2	17.6	18.8	19.4	20.0	19.0	20.2	20.9	21.5	19.4	20.7	21.4	22.0
	Efficiency (%)	85.6	85.7	85.7	85.8	85.1	85.2	85.3	85.3	84.6	84.6	84.8	84.8	84.5	84.5	84.6	84.7
	kW Input	18.7	20.0	20.6	21.3	20.7	22.1	22.8	23.4	22.4	23.9	24.6	25.4	22.9	24.5	25.3	26.0

DIMENSIONS



COUPLING DISC	
SAE	"AN"
6.5	30.2
7.5	30.2
8	62
10	53.8
11.5	39.6

1-BRG ADAPTOR	
SAE	"D"
5	361
4	405
3	451
2	489

8-HOLES SPACED AS 12
8-HOLES SPACED AS 12

2-BRG ADAPTOR	
SAE	"E"
5	359
4	406
3	455
2	493

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