1. GENERAL CONCEPTS

MAC Motors are three-phase asynchronous motors with **Forced ventilation** which have been specially designed for use in **high dynamic performance applications** with speed variation. They may only be **driven by Frequency Converters**. These Motors have been technically designed to be able to operate with the **DC Motors** specific characteristics (without their maintenance costs and with a wider range of operating speeds), and also to operate in a similar way to certain characteristics of **Brushless Servomotors** (without their demagnetizing problems, high repair costs and with a reduction in the cost of electronic drives).

2. MAIN TECHNICAL FEATURES

The following are de the technical features accordingly to the MAC series used

MAIN TECHNICAL CHARACTERISTICS	FACTOR	MAC					
		R		QE	QI	QX	QS
Nº Poles		4		4/6	4/6	4/6	4
Protection	Type	IP54		IP54	IP23	IP23	IP23
Cooling	Forced Ventilation	External		Internal Frame	Internal rotor	Internal rotor	Internal rotor
Operation at Constant Power	Nº times Nominal rpm	80-112	1,8	2,5-3,5	2-2,5	2,5-3,5	2-2,5
		132-160	1,5				
Compact frame with double shaft ends	Form	Circular		Square	Square	Square	Square
High temporary overload capacity	Nominal Torque	1,8		2,5	2,5	2,5	2,5
Reduced slip	Nº Hz	3-4		1,5-2	1,5-2	1,5-2	1,5-2
Specific Windings and insulations able to withstand high operating frequencies	Insulation Class	F		H	H	H	H
	Operating Type	F		F	F	F	F
Variable resistance thermal probes to protect against possible overheating	Thermal Probe	PTC		PTC	PTC	PTC	PTC

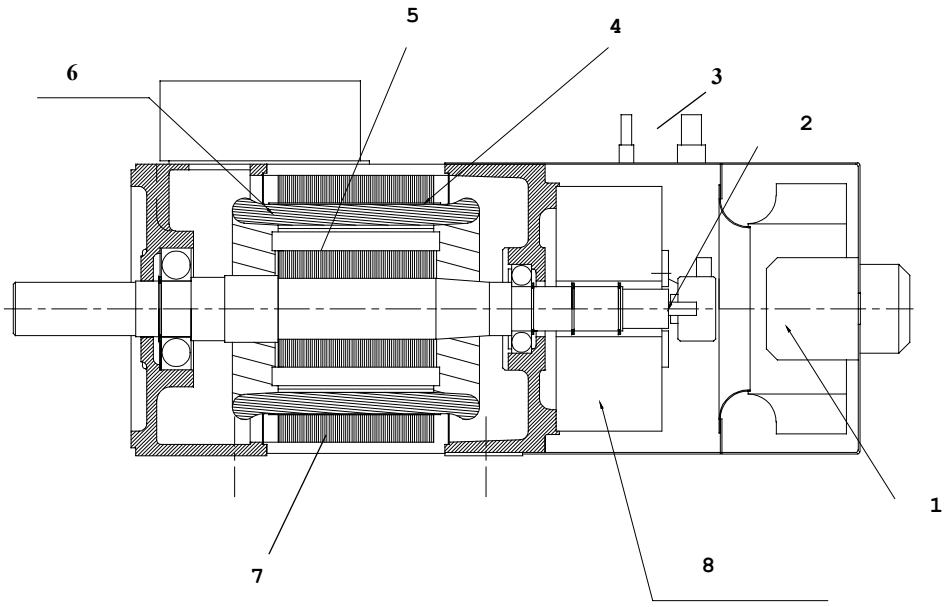
2. MAIN ADVANTAJES OF ITS USE

The following are de the advantages accordingly to the MAC series used

MAIN ADVANTAGES	MAC				
	R	QE	QI	QX	QS
Reduction in Motor size	-	X	X	X	X
Elimination of Reduction Gearing	X	X	X	X	X
Lower inertia Factor values therefore greater dynamic response	-	X	X	X	X
Run at wide range of Speeds at Constant Power	-	X	X	X	X
Availability of Nominal Torque from Zero Speed (with encoder feedback)	X	X	X	X	X
The ability to minimize full-load current consumption through matching operating speed with that of the machine shaft, thereby reducing Frequency Converter costs.	X	X	X	X	X

4. BASIC DESIGN FEATURES

The most important design features of MAC asynchronous motors are: Mechanical strength to allow high overloads, **high – efficiency insulation** to avoid gradual deterioration caused by working at high frequencies, **low inertia** to obtain a high dynamic value, excellent **thermal protection** devices and powerful **forced ventilation**.



1. Independent forced ventilation.
2. Shaft ready to take an encoder.
3. Connectors for brake and encoder (optional).
4. Reinforced insulation. Vacuum varnished.
5. Low – inertia rotor (only MAC-Q).
6. PTC thermal probes in windings.
7. Low – loss magnetic laminations (only MAC-Q).
8. Possibility of brake (on request).

5. BEARINGS

Bearings are located in the frame shields, which also incorporate the supporting feet granting the whole assembly a great sturdiness. Sealed for life ball bearings are used in frames up to 200 shaft height. MAC QI 250 to 355 are fitted with insulated bearings externally greased, These type of bearings can be fitted (under request) on 160 and 200 size. On 132 shaft height machines and over roller bearings at the drive shaft end can be fitted under request.

5.1. Bearings on MAC R Motors

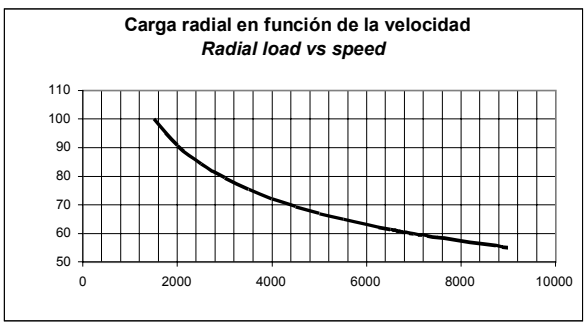
Tipo de motor *Motor Type*	Rodamiento *Bearing*		n max rpm	n rpm	L10h h	C N	P max N	A mm	B mm	Xmax mm	Fr max N (**)
MAC R 080.070	*D.E.*	*6204 ZZ*	*15000*	1500	20000	*12700*	1044	15	180	40	600
	N.D.E.	*6204 ZZ*	*15000*	1500	20000	*12700*	1044	15	180	40	2700
MAC R 090.100	*D.E.*	*6205 ZZ*	*12000*	1500	20000	*14000*	1151	17	205	50	700
	N.D.E.	*6205 ZZ*	*12000*	1500	20000	*14000*	1151	17	205	50	2800
MAC R 100.120	*D.E.*	*6206 ZZ*	*10000*	1500	20000	*19500*	1603	20	226	60	900
	N.D.E.	*6206 ZZ*	*10000*	1500	20000	*19500*	1603	20	226	60	3600
MAC R 112.140	*D.E.*	*6206 ZZ*	*10000*	1500	20000	*19500*	1603	20	240	60	1000
	N.D.E.	*6206 ZZ*	*10000*	1500	20000	*19500*	1603	20	240	60	3800
MAC R 132.125	*D.E.*	*6208 ZZ*	*8500*	1500	20000	*30700*	2524	25	268	80	1500
	N.D.E.	*6208 ZZ*	*8500*	1500	20000	*30700*	2524	25	268	80	5200
MAC R 132.170	*D.E.*	*6208 ZZ*	*8500*	1500	20000	*30700*	2524	25	306	80	1500
	N.D.E.	*6208 ZZ*	*8500*	1500	20000	*30700*	2524	25	306	80	5900
MAC R 160 M	*D.E.*	*6209 ZZ*	*8000*	1500	20000	*33200*	2729	30	375	110	1600
	N.D.E.	*6209 ZZ*	*8000*	1500	20000	*33200*	2729	30	375	110	5800
MAC R 160 L	*D.E.*	*6209 ZZ*	*8000*	1500	20000	*33200*	2729	30	420	110	1600
	N.D.E.	*6209 ZZ*	*8000*	1500	20000	*33200*	2729	30	420	110	6600

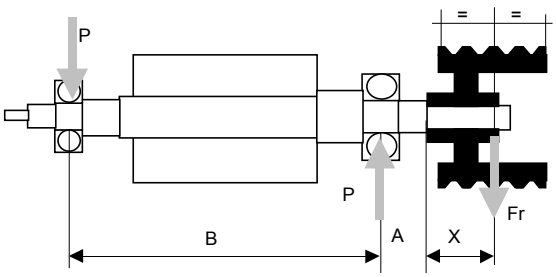
DE = Delantero / *Drive end* ; N.D.E. = Trasero / *Non Drive End*

(**) El esfuerzo radial máximo en la polea es el menor de los valores del juego de rodamientos seleccionado
The maximum radial load on the pulley is the minimum value for the selected couple of bearings

Los rodamientos de bolas con placas de obturación ZZ están engrasados de por vida.
Ball bearings with obturating plates type ZZ are greased for life

n max	Velocidad maxima / *Maximum speed*
n	Velocidad de trabajo / *Working Speed*
L10h	Vida util del rodamiento, en h / *Bearing Life in hours*
C	Carga dinámica nominal del rodamiento / *Rated Dynamic Load*
Pmax	Carga radial admisible en el rodamiento para L10h y n *Max. Radial load on the bearing for L10h and n*
Fr max	Esfuerzo radial máximo en la polea / *Maximum radial load on the pulley*





5.2. Bearings on MAC QE/QI/QX Motors

Tipo de motor *Motor Type*	Rodamiento *Bearing*		n max rpm	n rpm	L10h h	C N	P max N	A mm	B mm	Xmax mm	Fr max N (**)
MAC QE 063	D.E.	6203 ZZ	15000	1500	20000	9500	781	12	180	30	500
	N.D.E.	6203 ZZ	15000	1500	20000	9500	781	12	180	30	2700
MAC QE 071	D.E.	6204 ZZ	15000	1500	20000	12700	1044	15	180	40	600
	N.D.E.	6204 ZZ	15000	1500	20000	12700	1044	15	180	40	2700
MAC QE 080	D.E.	6205 ZZ	12000	1500	20000	14000	1151	17	205	50	700
	N.D.E.	6205 ZZ	12000	1500	20000	14000	1151	17	205	50	2800
MAC QE 090	D.E.	6206 ZZ	10000	1500	20000	19500	1603	20	226	60	900
	N.D.E.	6206 ZZ	10000	1500	20000	19500	1603	20	226	60	3600
MAC QE/QI 100	D.E.	6308ZZC3	7500	1500	20000	41000	3370	26,5	314	80	2000
	N.D.E.	6207ZZC3	9000	1500	20000	25500	2096	26,5	314	80	4900
MAC QE/QI 132	D.E.	6310ZZC3 N310 (*)	6300 5000	1500 1500	20000 20000	61800 110000	5080 11609	36,5	310,5	110	2800 6300
	N.D.E.	6208ZZC3	8500	1500	20000	30700	2524	36,5	310,5	110	4300
MAC QE/QI 160	D.E.	6312ZZC3 N312 (*)	5000 4300	1500 1500	20000 20000	81900 151000	6733 15937	35,5	503	110	4200 9900
	N.D.E.	6310ZZC3	6300	1500	20000	61800	5080	35,5	503	110	14100
MAC QI/QE 200	D.E.	6316ZZC3 N316 (*)	4000 3200	1500 1500	20000 20000	122000 260000	10029 27440	40,5	556,5	140	6100 16600
	N.D.E.	6312ZZC3	5000	1500	20000	114000	9372	40,5	556,5	140	23100
MAC QI 250	D.E.	6320 C3 (***) N320 (*)	3000 2400	1500 1500	20000 20000	163000 391000	13400 41266	58,5	691	170	8100 24800
	N.D.E.	6316 C3 (***)	3800	1500	20000	122000	10029	58,5	691	170	24300
MAC QI 280	D.E.	6224 C3 (***) N224 (*)	3000 2400	1500 1500	20000 20000	146000 335000	12002 35356	70	800	210	7100 21000
	N.D.E.	6224C3 (***)	3800	1500	20000	146000	12002	70	800	210	27400
MAC QI 355	D.E.	6230C3 (***) N230 (*)	2900 2400	1500 1500	20000 20000	176000 440000	14468 46438	80	900	250	8500 27200
	N.D.E.	6230C3 (***)	3800	1500	20000	176000	14468	80	900	250	31600

DE = Delantero / *Drive end* ; N.D.E. = Trasero / *Non Drive End*

(*) Ejecución con rodamiento de rodillos bajo pedido / *Roller bearing under request*

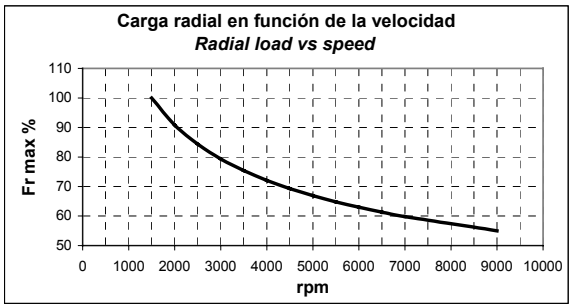
(**) El esfuerzo radial máximo en la polea es el menor de los valores del juego de rodamientos seleccionado
The maximum radial load on the pulley is the minimum value for the selected couple of bearings

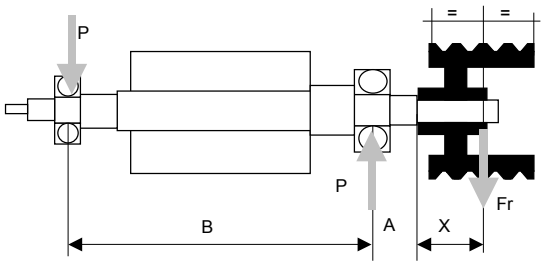
(***) Rodamientos de bolas aislados sin placas de obturación. / *Insulated ball bearings without obturating plates*

Los rodamientos de bolas con placas de obturación ZZ están engrasados de por vida.
Ball bearings with obturating plates type ZZ are greased for life

Los rodamientos de rodillos y los de bolas sin placas de obturación deben ser engrasados regularmente con grasa ESSO UNIREX N3.
Roller bearings and ball bearings without obturating plates must be greased regularly with ESSO UNIREX N3 grease.

n max	Velocidad maxima / *Maximum speed*
n	Velocidad de trabajo / *Working Speed*
L10h	Vida util del rodamiento, en h / *Bearing Life in hours*
C	Carga dinámica nominal del rodamiento / *Rated Dynamic Load*
Pmax	Carga radial admisible en el rodamiento para L10h y n / *Max. Radial load on the bearing for L10h and n*
Fr max	Esfuerzo radial máximo en la polea / *Maximum radial load on the pulley*





5.3. Bearings on MAC QS Motors

Standard Version

Tipo de motor *Motor Type*	Rodamiento *Bearing*		n max rpm	n rpm	L10h h	C N	P max N	A mm	B mm	Xmax mm	Fr max N (**)
MAC QS 132	*D.E.*	*6310 M C3*	*8500*	1500	20000	*61800*	5080	36.5	310.5	110	2800
	N.D.E.	*6208 M C3*	*10000*	1500	20000	*30700*	2524	36.5	310.5	110	4300
MAC QS 160	*D.E.*	*6312 M C3*	*7500*	1500	20000	*81900*	6733	35.5	503	110	4200
	N.D.E.	*6310 M C3*	*8500*	1500	20000	*61800*	5080	35.5	503	110	14100
MAC QS 200	*D.E.*	*6316 C3 (*)*	*6000*	3500	20000	*122000*	7562	40.5	556.5	140	4600
	N.D.E.	*6316 C3 (*)*	*6000*	3500	20000	*122000*	7562	40.5	556.5	140	18700
MAC QS 250	*D.E.*	*6316 C3 (*)*	*6000*	3500	20000	*122000*	7562	60	775	140	4800
	N.D.E.	*6316 C3 (*)*	*6000*	3500	20000	*122000*	7562	60	775	140	23400

Pair bearings version

Tipo de motor *Motor Type*	Rodamientos Apareados Cerámicos Ceramic Pair *Bearings*		n max rpm	n rpm	L10h h	C N	P max N	A mm	B mm	Xmax mm	Fr max N (**)
MAC QS 132	*D.E.*	2 x 50BNR10HTV1VDBELP3	*10000*	3500	11900	*12200*	899	36.5	310.5	110	500
	N.D.E.	2 x 40BNR10HTV1VDBELP3	*10000*	3500	14200	*10600*	736	36.5	310.5	110	1200
MAC QS 160	*D.E.*	2 x 60BNR10HTV1VDBELP3	*10000*	3500	9800	*15600*	1226	35.5	503	110	800
	N.D.E.	2 x 50BNR10HTV1VDBELP3	*10000*	3500	11900	*12200*	899	35.5	503	110	2500
MAC QS 200	*D.E.*	2 x 80BNR19HTXV1VDBELP3	*10000*	3500	7500	*22000*	1891	40.5	556.5	140	1100
	N.D.E.	2 x 80BNR19HTXV1VDBELP3	*10000*	3500	7500	*22000*	1891	40.5	556.5	140	4700
MAC QS 250	*D.E.*	2 x 80BNR19HTXV1VDBELP3	*10000*	3500	7500	*22000*	1891	60	775	140	1200
	N.D.E.	2 x 80BNR19HTXV1VDBELP3	*10000*	3500	7500	*22000*	1891	60	775	140	5900

Engrasados por vida / Greased for life

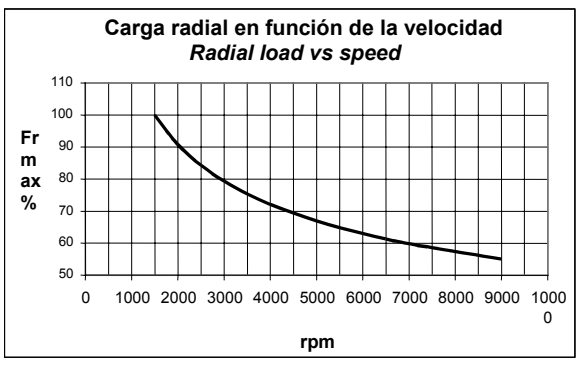
DE = Delantero /*Drive end* ; N.D.E. = Trasero /*Non Drive End*

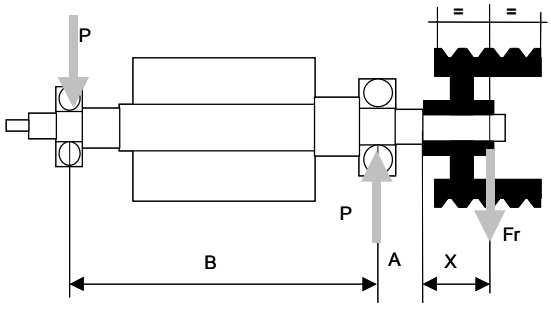
Rodamientos de bolas sin placas de obturación. Deben ser engrasados regularmente con grasa Klüber KLÜBERQUIET BQ72-72 o equivalente.
Ball bearings without obturating plates. Must be greased regularly with Klüber KLÜBERQUIET grease or equivalent.

(**) El esfuerzo radial máximo en la polea es el menor de los valores del juego de rodamientos seleccionado
The maximum radial load on the pulley is the minimum value for the selected couple of bearings

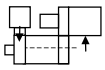
(*) rodamientos de bolas aislados sin placas de obturación. */nsulated ball bearings without obturating plates*

n max	Velocidad maxima /*Maximum speed*
n	Velocidad de trabajo /*Working Speed*
L10h	Vida util del rodamiento, en h /*Bearing Life in hours*
C	Carga dinámica nominal del rodamiento /*Rated Dynamic Load*
Pmax	Carga radial admisible en el rodamiento para L10h y n /*Max. Radial load on the bearing for L10h and n*
Fr max	Esfuerzo radial máximo en la polea /*Maximum radial load on the pulley*

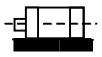
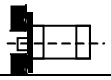




6. COOLING AND PROTECTION TYPES

EN60034-6	COOLING	PROTECTION	MAC R	MAC QE	MAC QX	MAC QI	MAC QS
	IC06	IP23/IP44	X	X	X	√	√
	IC16	IP23	X	X	X	√	√
	IC17	IP23	X	X	X	√	√
	IC37	P54	X	X	X	√	√
	IC416	IP54/55	√	√	X	X	X
	IC06 - axial	IP23	X	X	√	X	X
	IC06	IP44	X	X	X	√	√

7. DESING ANG MOUNTING

EN60034 - 7		Size			
		63 - 112	132	160	200-355
	IM B3 (1001)	✓	✓	✓	✓
	IM V5 (1011)	✓	✓	✓	●
	IM V6 (1031)	✓	✓	✓	●
	IM B5 (3001)	✓	●	×	×
	IM V1 (3011)	✓	✓	✓	●
	IM V3 (3031)	✓	✓	✓	●
	IM B3/B5 (2001)	✓	✓	✓	✓
	IM V1/V5 (2011)	✓	✓	✓	●
	IM V3/V6 (2031)	✓	✓	✓	●

√: Construction Possible X: Construction non Possible □: Construction on request

8. OPERATING TYPES AND CORRECTION FACTORS

Standard Operation

The data supplied in the MAC Motor selection tables and graphs described in the Technical Selection Sheets refer to the following working conditions:

Continuous Service S1
Maximum altitude 1000 m above sea level

Maximum ambient temperature: 40ºC
Heating level corresponding to class F insulation

Operation at different ambient temperature And altitude to standard.

For temperature and altitude conditions different to the standard ones described above, the torque and nominal power of the MAC motor must be multiplied by a factor K1.

Altitude	Temperature (ºC) 30ºC	40ºC	50ºC	55ºC
1000	1.00	1.00	0.92	0.86
2000	1.00	0.93	0.85	0.77
3000	0.93	0.85	0.76	0.69
4000	0.86	0.78	0.67	0.60

Factor K1

Example :
For a MAC 7,5 kW Motor at 1500 rpm, situated at an altitude of 2000 m and with ambient temperatures which may reach 50°C, the correction factor K1 will be 0.85. Therefore the real Nominal Power developed by the motor is 7,5 kW x 0.85 = 6.3 kW. To obtain a real Power of 7.5 kW, a MAC Motor of 7.5 kW / 0.85 = 9 kW must be selected.

Operation with Frequency Converter Output voltages different from the 400 or 230 V. Standard

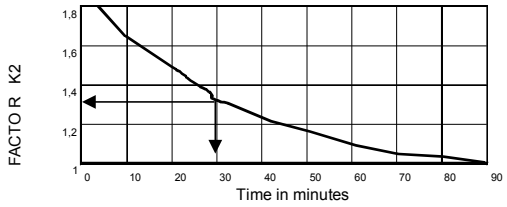
As each type of Frequency Converter has its own output voltages (depending on internal losses), then if the technician wishes to fine tune operating possibilities to their maximum, the following K4 correction factor must be applied.

$$\text{Factor K4} = \frac{\text{Converter Output Voltage}}{\text{Standard Catalogue Voltages}}$$

Example:
A MAC Motor supplied at 400V develops 16,7 kW at a frequency of 54,7 Hz y and 1591 rpm. If the Frequency Converter actually provides the MAC Motor with a voltage of 360V, then the following correction factor must be applied: Factor K4 = 360/400 = 0.9. The real MAC Motor technical operating values, therefore, change as below:
Real Nominal Power will be = 16.7 kW x 0.9 = 15 kW; real Nominal Frequency will be = 54.7 Hz x 0,9 = 49.2 Hz and real nominal rpm will be = 1591 x 0.9 = 1432 rpm.

Service S2
Intermittent Service

The operating time of the motor in relation to idle time is very short, which makes it impossible for the motor to reach working temperature. During the idle time, the motor cools back down to its initial temperature.

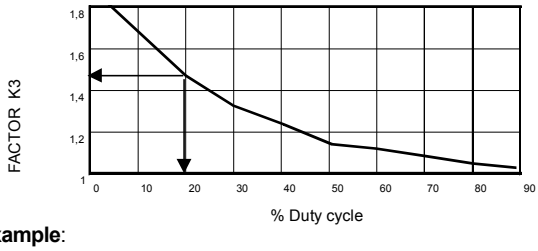


Example:
A MAC asynchronous motor of 7,5 kW at 1500 Rpm is made to work under S2 service of 30 minutes.
The nominal power of the motor under S2 service will be:
Pn = Pc x K2 = 7.5 x 1.37 = 10.27 kW.
and catalogue nominal power under S1 service to be chosen will be equivalent to:
Pc = Pn/K2 = 7.5/1.37 = 5.5 kW.

Pn = Nominal Power under S2 Pc = Nominal Power (catalogue) under S1
K2 = Correction Factor

Service S3
Intermittent Service

The motor performs work cycles during which operating time is significantly lower than idle time.



Example:
A MAC asynchronous motor of 7,5 kW at 1500 rpm is made to work at 20% intermittence, i.e. for every 50 minutes it works for 10 minutes and is idle for 40 minutes. The nominal power of the motor under S3 service will be:
Pn = Pc x K3 = 7.5 x 1.5 = 11.25 kW.
And catalogue nominal power under S1 to be chosen will be equivalent:
Pc = Pn/K3 = 7.5/1.5 = 5.kW

Pn = Nominal Power under S3 Pc = Nominal Power (catalogue) under S1
K3=Correction Factor