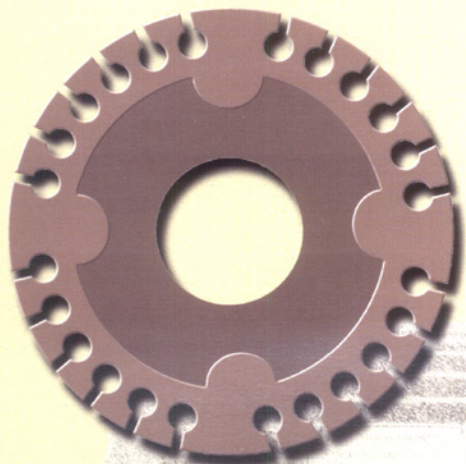
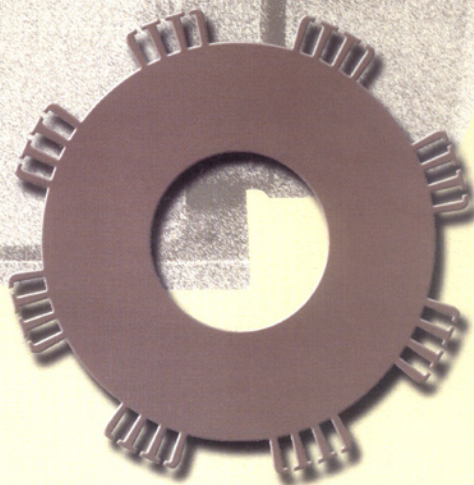


THREE PHASE SYNCHRONOUS MOTORS BRUSHLESS, TOTALLY ENCLOSED FAN COOLED

**PERMANENT
MAGNET
SYNCHRONOUS**



**RELUCTANCE
SYNCHRONOUS**



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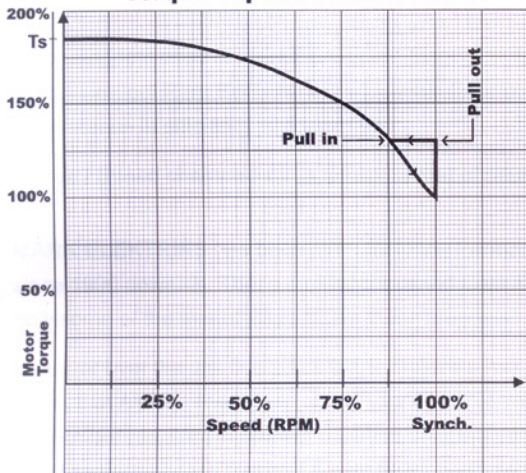
RELUCTANCE SYNCHRONOUS MOTORS

CONSTRUCTION & OPERATION :-

These motors resemble conventional squirrel cage induction motors except that the rotor has salient poles (without permanent magnets or exciting windings). These salient poles lock into step with the rotating field produced by the stator winding. The speed of rotation is determined by the supply line frequency.

Upon energizing the stator winding the reluctance motor behaves very much like an ordinary induction motor, accelerating upto @ 90 % of its synchronous speed. As the motor approaches synchronous speed the salient poles of the rotor lag behind rotating field of the stator. A synchronising torque is produced to pull in the rotor in step with the rotating field.

Torque - Speed Characteristic



T_s :- Starting Torque.

Pull in torque is the maximum load torque that the motor can pull into Synchronism.

Pull out torque is the maximum load torque that the motor can hold into Synchronism.

For better performance the inertia of load should be minimum so that the motor pulls into synchronism quickly. Pull out torque is not affected by load inertia.

Normally pull out torque is slightly higher than pull in torque.
of rated full load torque

Pull out torque @ 130 %}

Pull in torque @ 120 %}

These motors operate in synchronism with frequency applied. They provide constant unvarying speed from no load to full load with no slip. Inherent ruggedness, simplicity & ease of maintenance are major advantages of these motors. They offer low cost solution when synchronized speeds are required.

PERMANENT MAGNET SYNCHRONOUS MOTORS

CONSTRUCTION & OPERATION :-

These motors look like normal squirrel cage induction motors in appearance. The stator has normal three phase winding & rotor has got a squirrel cage for starting plus permanent magnets in the rotor to produce required number of poles.

Upon energizing the stator winding the motor behaves very much like an ordinary induction motor accelerating upto @ 90 % of its synchronous speed. As the motor approaches Synchronous Speed the permanent magnets in the rotor produce a synchronizing torque to pull the rotor in step with the rotating field produced by the stator winding.

Rotor magnets used in **Mark** Permanent Magnet Synchronous Motors are of very high energy product Rare Earth variety which results in compact size of motor & improved performance in efficiency & power factor.

Torque / Speed characteristic is similar to that of reluctance synchronous motor.

MARK ELEKTRIKS has been manufacturing Permanent Magnet Synchronous Motors since 1990 onwards. These motors contained Cast Alnico V Permanent Magnets. Even now some of the manufacturers use these magnets.

However over the last five years **Mark Elektriks** has incorporated Rare Earth Magnets in place of Alnico. These rare earth magnets have very high energy product & are very much more resistant to demagnetization compared to Alnico magnets. They improve the motor performance in terms of power factor & efficiency. Reduction in frame size & weight is also an added advantage.

COMMON SPECIFICATIONS FOR P.M. & RELUCTANCE SYNCHRONOUS MOTORS

ENCLOSURE : Totally enclosed fan cooled IP 44 / IP 54.

INSULATION CLASS : 'F' Standard ('H' Optional.)

AMBIENT TEMPERATURE : 45° C Standard. (Special Designs for max. ambient of 60° C)

Voltage to frequency ratio range available 2.5 to 8 V/Hz.

Normal operating frequency range 20 to 120 Hz. Below 20 Hz operation it is necessary to increase V/F ratio to balance the load torque for stable operation.

Conversions $N = \frac{120 F}{P}$ $P = \text{No. of Poles}$ Torque 1 lb ft = 0.138 Kg Meter
 $F = \text{Frequency Hz}$ = 1.35 Newton Meter
 $N = \text{RPM}$

OVERALL COMPARISON OF THE TWO TYPES (MARK MAKE) (FOR SAME OUTPUT RATING)

PARTICULARS	RELUCTANCE SYN.MOTOR	P.M. SYN. MOTOR.
Size & weight	Larger frame size & weight	Same as standard induction motor
Power factor	Low (max. 0.5)	High (upto 0.85)
Efficiency	Good	Good
Rated Current	Approximately double of P.M. Syn.Motor	Approximately Half of Rel.Syn.Motor
Cost / Price	Same for both varieties.	

For a given rating of motor the VA Capacity of the variable frequency source (say inverter, VFD) required to drive Reluctance Synchronous Motor will be approximately double than that for P.M. Syn. Motor.

GENERAL

At MARK ELEKTRIKS both types (Reluctance & P.M.) of Synchronous motors have been manufactured & supplied to reputed clientele all over India. Synthetic Fiber making machinery & Glass making machinery have been major clients. A list of motor specifications & client details is attached with this catalogue.

In addition to the standard frames & ratings given in this Catalogue, MARK ELEKTRIKS designs & manufactures non-standard frames & electrical ratings as per customer requirement.

APPLICATIONS

These motors can be used when several motors must operate in synchronism for co-ordinating machines & where a wide range of highly regulated speed control is required with a variable frequency drive.

- | | | |
|---|--|--|
| <input type="checkbox"/> Synthetic Fibre Industry | <input type="checkbox"/> Textile Machinery | <input type="checkbox"/> Pumps & Conveyors |
| <input type="checkbox"/> Glass Making Machinery | <input type="checkbox"/> Wrapping & Folding Machines | |

RELUCTANCE SYN.MOTOR RATINGS & FRAME SIZES

4 POLE MOTORS

NEMA FRAME	IEC FRAME	FULL LOAD TORQUE		OUTPUT KW @ 50 Hz, 415 V
		N.m	lb - ft	
184 T	112 M	9.6	7	1.5
213 T	132 S	18	13	2.7
215 T	132 M	28	20.3	4.4
254 T	160 M	28	20.3	4.4
256 T	160 L	36	26.6	5.6

6 POLE MOTORS

NEMA FRAME	IEC FRAME	FULL LOAD TORQUE		OUTPUT KW @ 50 Hz, 415 V
		N.m	lb - ft	
213 T	132 S	20	14.5	2.0
215 T	132 M	25	18	2.6
254 T	160 M	34	24.5	3.6
256 T	160 L	50	36	5.2

8 POLE MOTORS

NEMA FRAME	IEC FRAME	FULL LOAD TORQUE		OUTPUT KW @ 50 Hz, 415 V
		N.m	lb - ft	
213 T	132 S	15	10.8	1.2
215 T	132 M	19	13.8	1.5
254 T	160 M	28	20.3	2.2
256 T	160 L	40	29	3.0

Power Factor & efficiency values for above motors lie between 0.35 to 0.5 & 55 % to 75 % respectively. The product of power factor & efficiency is between 0.25 to 0.32.

Starting torque value between 150 % to 200 % of rated torque
Starting Current value between 500 % to 700 % of rated current.

Pull out torque value between 140 to 160 % of rated torque.
Pull in torque value between 120 to 140 % of rated torque.

PERMANENT MAGNET SYNCHRONOUS MOTOR RATINGS & FRAME SIZES

4 POLE MOTORS

FRAME NEMA	IEC FRAME	FULL LOAD TORQUE		OUTPUT KW AT 50 HZ, 415 V @ 415 V, 50 HZ	FULL LOAD CURRENT AMPS
		N.m	lb- Ft		
56	80	1.6	1.2	0.25	0.65
56	80	2.4	1.8	0.37	0.72
143 T	90 S	3.5	2.6	0.55	1.3
145 T	90 L	4.8	3.5	0.75	1.8
145 T	90 L	7	5.1	1.1	2.7
66	100 L	9.6	7	1.5	3.4
184 T	112 M	14.5	10.6	2.2	4.7
213 T	132 S	24	17.5	3.7	7.8
215 T	132 M	29	21	4.5	9.5

6 POLE MOTORS

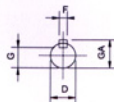
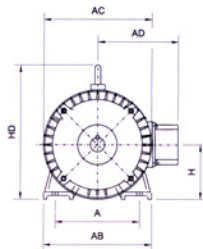
FRAME NEMA	IEC FRAME	FULL LOAD TORQUE		OUTPUT KW AT 50 HZ, 415 V	FULL LOAD CURRENT AMPS @ 415 V, 50 HZ
		N.m	lb- Ft		
56	80	2.4	1.8	0.25	0.65
143 T	90 S	3.5	2.6	0.37	0.8
145 T	90 L	5.4	4	0.55	1.4
145 T /66	90 L /100 L	7	5.1	0.75	1.7
184 T	112 M	10	7.4	1.1	2.6
184 T	112 M	14	10.5	1.5	3.4
213 T	132 S	22	16	2.2	5.2
215 T	132 M	36	26	3.7	8.6

Power factor & efficiency values for above motors lie between 0.65 to 0.85 & 75 % to 85 % respectively. The product of power factor & efficiency is between 0.55 to 0.7.

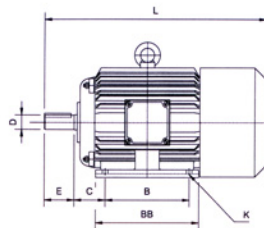
Starting torque value between 150 to 200 % of rated torque.
Starting current value between 300 to 500 % of rated current.

Pull out torque value between 140 to 160 % of rated torque.
Pull out torque value between 120 to 140 % of rated torque.

OUTLINE DIMENSIONS DRAWING THREE PHASE SYNCHRONOUS MOTORS



END VIEW OF SHAFT



FRAME SIZE	H	A	AB	B	BB	C	K	AD	AC	HD	D	E	F	G	GA	L
80	80	125	155	100	130	50	9	128	160	160	19	40	6	15.5	21.5	288
90-S	90	140	180	100	147	56	10	140	182	180	24	50	8	20	27	316
90-L	90	140	180	140	172	51.5	10	140	182	180	24	50	8	20	27	341
100-L	100	160	200	140	170	63	12	168	210	259	28	60	8	24	31	384
112-M	112	190	230	140	180	70	12	176	225	280	28	60	8	24	31	397
132-S	132	216	256	140	195	89	12	195	264	320	38	80	10	33	41	472
132-M	132	216	256	240	280	89	12	195	264	320	38	80	10	33	41	560
160-M	160	254	304	210	260	108	15	235	320	380	42	110	12	37	45	582
160-L	160	254	304	254	314	108	15	235	320	380	42	110	12	37	45	625

NOTES :

- 1) FLANGE MOUNTING MOTORS ARE AVAILABLE IN 80 TO 112-M FRAME SIZES.
- 2) ALL DIMENSIONS ARE SUBJECT TO ALTERATION ON IMPROVEMENTS IN DESIGN.
- 3) ALL DIMENSIONS ARE IN MM.