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The Society of Power Engineers (India)

Vadodara Chapter (Estd. 1996)

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KARGIL VIJAY DIVAS-26 JUL 21
SALUTE TO OUR KARGIL HEROES

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Change: Covid

See by the coming of a deadly virus
We all are stuck in our house
Waiting for vaccinated
To get out of this invisible bond
But see by the coming of this virus
Our lifestyle has changed
Education system is changing
And surely in the future, our stubborn
Government will change
This virus may be lethal towards humans
But it is improving humanity
It is showing person other values
And thus, is helping in the betterment of our tiny world

Prerak Patel

(He is a grandson of Er. KH Patel, LM-SPE(I) Vadodara)

FROM THE CHAIRMAN'S DESK



Dear Readers,

The Covid-19 has affected the world over. The chapter has lost many members and well-wishers during the first wave & second wave. It has also caused lot of damage to the activities of SPE(I) Vadodara.

To start with, the monthly meetings of Executive Committee (EC) and Advisory Committee (AC) which were regularly being held in the office of the chapter in Avishkar Complex by default on first Sunday of every month, is now being held virtually. The same agenda is perused but the charm of physical meeting is not attained. The fervor of meeting, cutting jokes, teasing each other, having sumptuous snacks etc. is totally missing. As a matter of fact, the EC & AC members are longing for a physical meeting. From March-2020 till date there were only three physical meetings. However, for the fear of Covid-19 the presence was poor. The Silver Jubilee functions are totally put on hold, in spite of the fact that donations from the members and the well-wishers are pouring in. The annual day Satyanarayan Puja in October-2020 was also on a low key with the presence of four members and the priest. The main source of revenue of the Chapter was through seminars on various themes organized at various places in the state of Gujarat. This source is totally dry as of now except for few paid webinars organised in association with CBIP-Cigre on profit sharing basis. The monthly lecture sessions were organized by the Chapter uninterruptedly for 23 years till the pandemic broke in. In addition to the knowledge sharing the event was also looked at by many members as a technical get together. The dinner which used to follow the lecture session was an added attraction, which provided time off for mutual engagement on technical, business, personal and social fronts.

The publication of quarterly house journal "SPE News Letter" is also delayed due to pandemic & work from home situation. The office bearers of the chapter in association with EC & AC members have started focusing on webinars & web meetings. Those who are keeping in touch with the chapter's activities through WhatsApp and E-Mail, are well aware that the chapter is very active in keeping the stream of activities flowing. In absence of personal meetings also there are lot many activities being conducted online / virtually.

Recently the chapter organized virtual lecture sessions for the benefit of the members. Even some virtual lecture programs and seminars were organized for college students as well. The response to such events was over whelming. The chapter also joined hands with the premium organizations like CBI&P New Delhi, IEEMA, CIGRE (India) etc. in organizing bigger webinars. Some of the events have brought in some revenue for the Chapter.

As stated above, the sources of income have reduced during pandemic. However, to meet with the minimum expenses of the chapter (like office, power bill, taxes etc.) the corpus is diminishing slowly but surely.

The EC & AC of the chapter are actively engaged in looking for a larger accommodation for the office of the chapter. It is envisaged to buy a property with a minimum of 700 Sq. Ft. carpet area with good parking space, security arrangement and good maintenance and preferably a bit off the main road. The reader members can also help the EC/AC in this endeavor and suggest some suitable accommodation. An appeal is also being made to all the members and well-wishers to donate generously for the acquisition of bigger premises for the chapter's office. Further, an appeal is also made to all the reader members to take the benefits of webinars organized by the chapter in collaboration of other professional bodies. The members may rope in paid delegates for such webinars to raise chapters income. The members are also requested to enthuse the engineers in their known circle to be a Life Member of SPE(I) Vadodara.

Let us all pray the almighty to bring an early end to the pandemic and simultaneously follow Covid-19 protocols

Er. GV Akre



EDITORIAL:



Dear Readers,

Friction can be physical or mental, but it is considered to be un-desirable. The effect of friction is generation of heat and loss of energy. Everyone tries to avoid or minimize

friction. Resistance is the main cause of friction. It is well known that all electrical and electronic items generate direct or indirect heat due to the resistance of conducting bodies. Mechanical motion is resisted by friction of connected parts. The moving vehicles, Trains and Aircrafts are resisted by the air by road surface, rail track and cause retardation and resultant friction and heating.

In the rotary motion afforded by generators, motors, pumps etc., there is a provision of ball bearings to reduce the friction to an acceptable level. Still there is going to be a friction. The generator rotor bearings need cooling oil.

The mental friction is generated due to maladjustment in workplace, houses, public places and gatherings. Ego, intolerance, self-contentedness, dominance, misunderstanding, jealousy and mistakes also cause mental friction. Sometimes the mental friction also results into physical friction.

The political friction is the combination of all the causes indicated above. The results of the political friction are well known to everyone. Two world wars were the results of political friction. The trend continues even today.

But the question is, can the earth and life survive with zero friction? The answer is "NO". Just imagine a situation when an element of friction is reduced to "zero" for even a minute, what will happen?

Let us have a look at the physical friction first

- The moving train will not be able to stop at railway station.
- We may fall down while walking
- Generators will over speed affecting the increase in power frequency.
- The flying aircraft will zoom past the airport or landing may be difficult.
- Vehicles will move uncontrollably and skid.
- Writing on a paper or a board will be very difficult.
- The clock will show erratic time.

- All morning routine starting from brushing of teeth will be difficult.
- Computer printing, playing outdoor games, cycling etc. will be also difficult.
- Cleaning of your body, utensils, clothes etc. will be hampered.
- Eating will be a big problem, cutting vegetable fruits etc. will be difficult

The list is endless and can be extended as per one's imagination.

Talking about the mental friction, again some of the possibilities are as under

- (if this type of friction takes a holiday for months)
- No litigation & court cases
- There may not be fear of law or examination or family control mechanism
- No mental stress will create a vacuum at workplace, competitive sports and the trade world over
- Lawyers & judges may find it difficult to justify their position and survival.

The holiday to political friction may sound very good but it is not so. Longer holiday to political friction may lead to number of hazards like

- The collapse of political system with free for all situations
- The arms dealers, manufacturers & users will be jobless along with defense personnel.
- Trade will become stagnant or erratic.
- Again, the list is endless

Newton's law says that for equilibrium it is necessary that each force in each direction needs to be countered by similar force from opposite direction. Thus, the friction comes into picture. Smooth sailing is not the theme of the life and therefore accept the friction as a necessary evil in our day to day life.

Remember, let the friction work for you and not against you. Prayer to almighty for safety of our members and their families during Covid-19.

Er. SM Takalkar
Vice-Chairman





CHAPTER'S ACTIVITIES

➤ On **24 Apr 2021**, a **Webinar** was arranged to educate the SPE(I) Vadodara members regarding joining and participating in **Webinar & Web Meeting**. This particular Webinar was arranged as many members were finding it difficult to participate in the Webinars and Web meeting.



The first speaker was **Er. YK Sharma**, EC member of SPE(I) Vadodara. In his presentation, he nicely demonstrated the steps to be followed to join the Web meeting and also the role of the Administrator, the host, co-ordinator, the speaker and the participants. He described in detail how to mute, unmute, video on/off, raise the hand for question, type the questions etc.



The second speaker was **Er. DC Mehta**, AC Member, SPE(I) Vadodara. Er. Mehta explained details of Website pages i.e. Home, about us, Profile of SPE(I) Vadodara, Membership data, Committees, Aims & Objectives,

NEWS Letter from 2014 onwards, Contact us etc. He also briefed about new development like online Membership Registrations and e-voting programme.

The lectures/presentations were very useful.

Er. Keval Velani was the co-ordinator.

Vote of thanks was given by **Er. Umesh Parikh** (Advisory Committee Member)

➤ On **18 May 2021**, **Chapter** and **Parul University** jointly organized a **1-Day Webinar** on **“Power System Case Studies”**. The talk by Expert speakers from Hivoltrans Electrical Pvt. Ltd.-Halol, Hitachi ABB Power Grids-Faridabad, Takalkar Power Engineers & Consultants - Vadodara and Soham Technologies - Vadodara evolved on following:



1. Case Studies on Failures of Instrument Transformers by **Er. GV Akre**, Chairman, SPE(I) Vadodara and **Promoter Director** - Hivoltrans Electricals.



2. Grid Integration Aspects of Micro Grid by **Dr. Shivani Sharma**, Life Member & Patron - SPE(I) Vadodara and **Principal Technical Consultant** - Hitachi ABB Power Grids.



3. Industrial Electrification by **Er. SM Takalkar**, Vice-Chairman - SPE(I) Vadodara and **Managing Director** - Takalkar Power Engineers & Consultants.



4. Case Studies on Energy Audit by **Er. BN Raval**, Advisory Member - SPE(I) Vadodara and **Managing Director**- Soham Technologies.

In the beginning, **Er. YV Joshi**, Secretary-SPE(I) Vadodara presented welcome address.

Er. PA Shah, LM & Advisory Member-SPE(I) Vadodara was the **Moderator** of the Webinar.

This Webinar was attended by **926** participants. This includes students, faculties from Parul and other degree and diploma colleges, members of SPE(I) Vadodara, practicing engineers and professionals from Industry / Utilities etc.

Event was appreciated by all.

➤ On **19 Jun 2021**, **Chapter**, organized a **Webinar** on **“New Generation Conductors – Blessings to the Power Transmission Segment”**. **Er. SM Takalkar** Vice-Chairman-SPE(I) Vadodara and **MD** - Takalkar Power Engineers & Consultants, was the speaker.

In the beginning, **Er. GV Akre**, Chairman-SPE(I) Vadodara presented welcome address.

Dr. Shivani Sharma, LM & Patron-SPE(I) Vadodara, was the **Moderator** of the Webinar.

In the presentation, Er. Takalkar explained as to how the New Generation Conductor help in up-rating & up-gradation of existing lines.

➤ On **25 Jun 2021**, **Chapter**, in association with **Electrical Engineering Department, GEC, Dahod**, organized a **Webinar** on **“Solar Power and its Impact on Consumers of Gujarat”**.

The speaker, **Er. YK Sharma**, Executive Member - SPE(I) Vadodara revolved round the following:

1. **Environmental Issues.**
2. **Pollution.**
3. **Global warming and increasing Energy demand.**
4. **More concentration on Distributed Energy.**
5. **Types of Renewable Energy.**
6. **Solar Energy implementation up to generation and details of Solar Rooftop components.**
7. **Impact of Distributed Generation on consumers of Gujarat.**

➤ On **26 Jun 2021**, **Chapter** organized a **Webinar** on **“Impact of Energy Efficiency Measures”**. **Er. BN Raval**, Advisory Member and MD, Soham Technology was the speaker.

He presented as to how the saving in electricity in Industry is feasible and what are its impacts. Data related to past 20 years was presented indicating reduction in usage of other resources like furnace oil, Gas, coal etc. due to electrical energy savings.

As per BEE, the sector wise energy savings done in the year 2019 shows 10,566 MUs corresponding to saving of 24,05,532 Tons of oil & 17.3 Million Tons of greenhouse gases. This shows how important energy savings is.

The sectors covered in savings are Industries, Domestic, Commercial buildings, transports including Railways, Agriculture and other utilities. However, the major contribution was from Domestic amounting to Rs. 53,896 Crore out of total 1,15,702 Crore during year 2019-20.

He explained the ways and means of EE in various schemes and programs run through years and major stake holders and gave list of standards.

He also explained the most favourite UJALA scheme wherein LED bulbs, fans and tube lights, Solar Agricultural pump sets etc. which are distributed at concessional rates to common public.

In the beginning, **Er. YV Joshi**, Secretary-SPE(I) Vadodara presented welcome address.

Er. Keval Velani, Executive Member-SPE(I) Vadodara was the **Moderator** of the Webinar.

Er. YV Joshi
Secretary

NEW LIFE / YEARLY MEMBERS ENROLLED

G.R. No.	Grade	Name	G.R. No.	Grade	Name
2352	Insti. LM	Pragnesh K Brahmhatt	2354	LM	Ashish P Shah
2353	AM (2021-22)	Pooja V Trivedi	2355	AM (2021-22)	Harshil Y Joshi



High Efficiency Motors - Some recent developments

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Hon. Life Fellow
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Abstract: More than 75% of Electricity in India is used by Electric Motors. High Efficiency Motors play a crucial role in electricity conservation. They are also essential to meet challenges of global warming and climate change. Indian Standard for high efficiency motors (IS 12615) has been recently revised (2018) to bring it in line with International Standard IEC. Key features of these standards are discussed. Special characteristics of high efficiency motors are discussed along with case studies. Application considerations like payback periods, rewinding is also discussed. Permanent Magnet Synchronous Motors, which are now widely used in electric vehicles, are also discussed.

Key Words: High Efficiency motor, Indian and International Standards, Special Characteristics, Permanent Magnet Synchronous Motors, Application Areas.

2. Introduction:

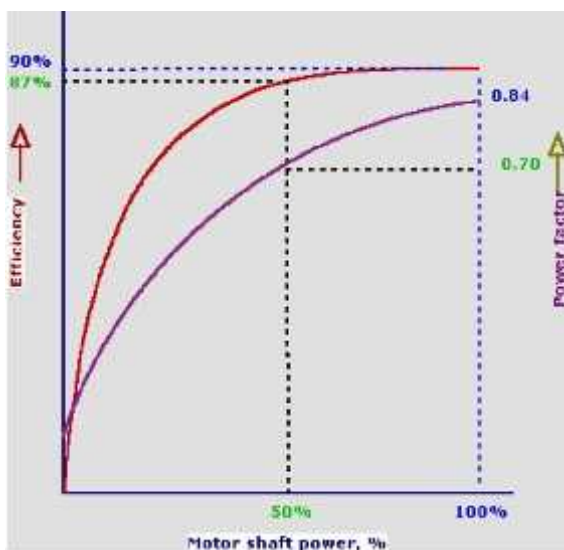
Electric Motors are used widely in industry, commerce, agriculture, residences and even in transport. In India Motors account for 75% of electricity consumption, lighting accounts for 15%, heating, electrolysis consumed another 10%.

Induction Motors account for more than 90% of all motors. Synchronous motors, DC motors and others account for 10%

3. Motor Performance

Fig. 1 shows how Efficiency and Performance varies with Load for Induction Motor

Fig. 1



1. Efficiency remains approximately same from 50% to 100%. It then declines with load and drops to zero at zero loads.
2. Power factor continues to decline with load. Full load Power Factor will be 0.8 -0.85. No Load Power Factor will be around 0.1
3. Power Factor can be corrected externally with capacitors. Efficiency cannot be improved by external means.
4. For many High Efficiency Motors, Maximum Efficiency occurs at 75 % load.

Other Important Parameters are

1. Starting Current
2. Starting Torque
3. Breakdown Torque
4. Rated Speed
5. Rated Current

These values are given in IS 12615-2018 (Ref. 1)

1. Importance of Running Cost

Motor life is in range of 10 to 20 years. In fact, motors are repeatedly rewound and continue to run for 30–40 years before they are scrapped. Even now in 2019 when electricity prices for Industry/Commerce range between Rs. 7 to Rs. 9 per kWh. Motors continue to be purchased on basis of initial or first cost. Initial or First Cost is negligible compared to total cost of running the Motor.

Table-1 shows the running cost for 11kW 4-Pole Motor of different efficiency classes IE1, IE2, IE3, IE4.

Following points can be noted from Table -1.

1. Initial cost of purchasing a Motor is negligible, (1% to 2%) compared to running cost of motor for 10 years.
2. Importance should be given to Running Cost which depends on efficiency of Motor rather than Initial Cost.
3. It can be seen from above table that extra cost for purchasing High Efficiency Motor is recovered in about one year.

Table-1
**Importance of running cost
11kW 4-POLE MOTOR**

	IE1	IE2	IE3	IE4
Efficiency	87.6	89.8	91.4	93.3
Output (kW)	11	11	11	11
Input (kW) = Output ÷ Efficiency	12.557	12.249	12.035	11.789
Running Hour/Yr.	7,000	7,000	7,000	7,000
kWH/Yr.	87,899	85,743	84,245	82,523
Running Cost/Yr. (Rs.)- 7Rs. /kWH	6,15,293	6,00,201	5,89,715	5,77,661
Saving/Yr. (Rs.)		15,092	25,578	37,632
Running Cost/10 Yr. (Rs.)	61,52,930	60,02,010	58,97,150	57,76,610
Initial Cost (Rs.)	90,000	1,00,000	1,15,000	1,40,000
Initial Cost % of Running Cost	1.46%	1.66%	1.95%	2.42%
Extra First Cost Compared IE1 (Rs.)		10,000	25,000	50,000
Time to Recover Extra Cost		8 Months	1 Yr.	16 Months

4. Development of Motor Efficiency Standards

Motor Efficiency has gained importance after the energy crisis of 1973. Concern of global warming and climate change has further pushed the importance of Energy Efficiency and Motor Efficiency. Minimum Motor Efficiency standards are now mandated around the world, USA, Europe, Japan, China and now in India also.

IEC 60034-30-1-2014 (Ref.-2) is the current International Standard for Motor Efficiency. It defines four classes of efficiency IE1, IE2, IE3, IE4. It also mentions IE5 but values are not defined. Standard only mentions IE1, IE2, IE3, IE4 but in common technical language following nomenclature is used.

- IE1 Standard Efficiency
- IE2 High Efficiency
- IE3 Premium Efficiency
- IE4 Super Premium Efficiency

Previous IEC as well as Indian Standards use to cover only Induction Motor. Now IEC as well new Indian Standard include all line start Motors and not only Induction Motor.

Important part of the motor efficiency development has been how to test motor efficiency. US Standard IEEE 112 used to determine efficiency by load test. European and Japanese standard and also Indian standard used to prefer summation of losses with value of stray load losses at 0.5%. IEEE insisted on measurement of stray losses or take as a value which is much

more than 0.5%. This caused different efficiency values of Motor by different standard. Now all IEC and American Standard are harmonized and uses the same test procedure. Stray loss measurement is very difficult, and few test laboratories or manufacturers have facility to do it. Following are stray load loss allowances for new standard. (Ref. 3 & 4) gives details of relevant standard

Table-2

IEC 60034-2-1	IEEE-112
1kW - 2.5%	1.8% -100kW
10kW -2%	1.5% -375kW
100kW -1.5%	1.2% -2000kW
1,000kW-1%	0.90% - Others
10,000kW-0.5%	

5. Revised Indian Standard IS12615-2018 (Ref. 3)

Bureau of Indian Standard has IS 12615 for high efficiency motors since nearly 30 years 1989. It was revised in 2004 as well as 2011. Now IS 12615 -2018 has been revised which is in line IEC Standard 60034-30-1-2014 (Ref. 4). New Indian Standard has similar efficiency values of IE1 IE2 IE3 IE4 as per International standard. It covers like IEC all line operated Motors and not only Induction Motors. Some differences are as follow.

IEC Standard covers 50HZ and 60HZ Motors. Indian Standard covers only 50HZ. Indian Standard does not include IE1 now. Indian Standard specifies following additional performance values.

Starting Current
Starting Torque
Breakdown Torque
Rated Speed
Rated Current

Efficiency to be determined by IS-15999-2011 which is in line with revised IEC Standard 60034 - 2-1-2007

Performance Values for some 4-Pole Motors are given in Table-3 and Table -4

Table-3
IS 12615: 2018-PERFORMANCE
VALUES FOR 4-POLE

	Rated Output	Frame Size	Nominal Efficiency		
			IE2	IE3	IE4
	kW				
1	0.55	80	77.1	80.8	83.9
2	1.1	90S	81.4	84.1	87.2
3	2.2	100L	84.3	86.7	89.5
4	3.7	112M	86.3	88.4	90.9
5	5.5	132S	87.7	89.6	91.9
6	7.5	132M	88.7	90.4	92.6
7	11.0	160M	89.8	91.4	93.3
8	15.0	160L	90.6	92.1	93.9
9	22.0	180L	91.6	93.0	94.5
10	37.0	225S	92.7	93.9	95.2
11	55.0	250M	93.5	94.6	95.7
12	90.0	280M	94.2	95.2	96.1
13	160	315L	94.9	95.8	96.6

Table-4
IS 12615: 2018-PERFORMANCE VALUES FOR 4-POLE

Rated Output kW	Full Load Speed rev/min	Full Load Current Max A	Locked Torque in Terms of Full load Torque %	Locked Rotor Current in Terms of Full Load Current		
				IE2 %	IE3 %	IE4 %
0.55	1 340	1.7	170	600	650	700
1.1	1 370	2.9	170	600	650	700
2.2	1 390	5.1	170	700	750	830
3.7	1 410	8.1	160	700	750	830
5.5	1420	12.0	160	700	750	830
7.5	1430	15.4	160	700	750	830
11.0	1440	22.0	160	700	750	830
15.0	1440	30.0	160	700	750	830
22.0	1440	43.0	160	700	750	830
37.0	1450	63.0	160	700	750	830
55.0	1460	101.0	160	700	750	830
90.0	1470	164.0	160	700	770	890
160	1480	288.0	160	700	770	890

6. High Efficiency Motor Technology

Induction Motor Losses are as follows

- Stator Copper Losses
 - Rotor Copper Losses
 - Iron Losses
 - Friction and windage Losses
 - Stray Losses
- b) Stator Copper losses are reduced by increasing Stator Copper area, increasing slot fill factor as well as reducing overhang length by machine winding.
- c) Rotor Copper Losses are reduced by increasing aluminum area in rotor slots and end rings. Copper cast rotors are also being used.
- d) Iron losses are reduced by better quality of stamping as well as use of thinner lamination.
- e) Friction losses are reduced by improved bearing and fan design. Advantage is also taken of fact that lower cooling is required in

view of lower losses of high efficiency motors
a) Stray Losses are controlled by air gap, rotor stator slot combination and better manufacturing.

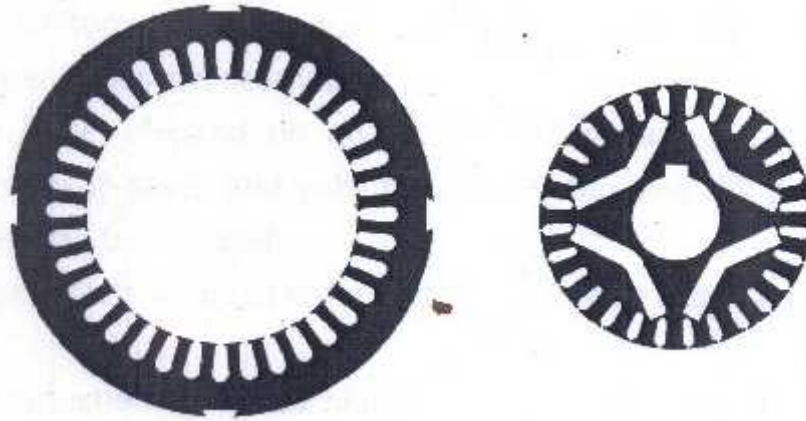
7. Permanent Magnet Synchronous Motors (PMSM)

PMSM Motors are now widely used in industries and especially in electric vehicles. They can achieve higher efficiency than conventional induction motors.

Since line start Motors are only specified, Permanent-Magnet Synchronous Motors are other practical option. Brushless DC motors and Synchronous Reluctance motors require a static converter to start and run.

PMSM motors are like normal induction motors except rotor has Permanent magnets.

Fig. 2: Stator and Rotor stampings of PMSM Motor



Stator Stamping

Rotor Stamping

Motor starts like an Induction Motor but due to permanent magnets runs at synchronous speed. Efficiency is improved as stator current is less because of higher power factor. Rotor losses are nearly zero.

Iron Losses, Friction, windage, stray losses are like normal motor

Table-5 gives comparison of Standard and Permanent Magnet Synchronous Motors

Table-5: Performance Comparison

Particulars	PMSM Motor	Standard Motor
Applicable Standard	IS 12615-2018 (IE3)	IS 12615-2018 (IE2)
Rating	5.5kW	5.5kW
Rated Speed	1500RPM	1420RPM
Starting Torque	200%	160% (Min)
Nominal Efficiency	90.0%	87.7%
Power factor	0.80	-
Rated Current	11.6A	12.0A (Max)

Table-6 gives data about PMSM for Submersible Pump showing significant improvement in efficiency.

Table-6: Performance Comparison

Particulars	PM Sub. Motor	Standard Sub. Motor
Applicable Standard	-	IS 9283-2013
Rating	5.5 kW	5.5 KW
Rated Speed	3000 RPM	2810 RPM
Starting Torque	180 %	125 % (Min)
Efficiency (%)	83.5 %	77.0 %
Rated Current	10.5 A	14.5 A

8. MARKET SHARE INDIA

- IE4 less than 5%
- IE3 15% to 20%
- IE2 40% to 50%
- IE1 or less 25% or more

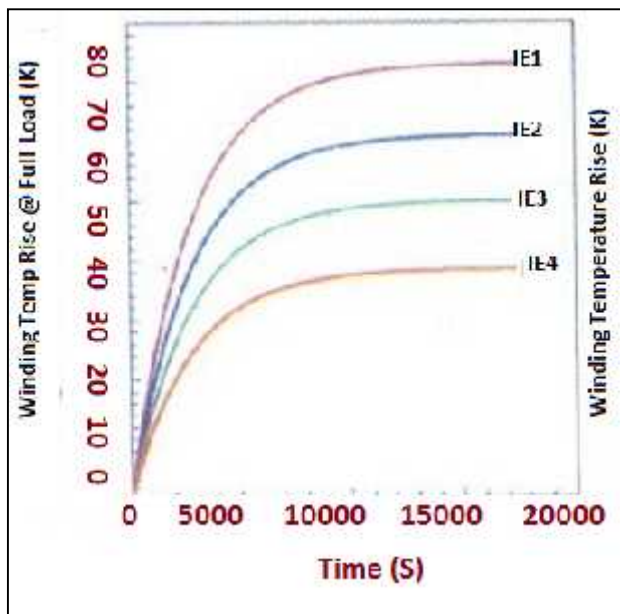
9. Other characteristics of High Efficiency Motors

(a) Lower Temperature Rise & Longer Life

Lower temperature rise lead to longer life for high efficiency motors

Figure-3: (Ref. 5) shows temperature rise for IE1 IE2 IE3 IE4 motors

Figure-3:(Ref. 5) shows temperature rise for IE1, IE2, IE3, IE4 motors.



(b) Lower Slip and higher Speed.

For Motor Loads like Pump, Fans, Output power varies as cube of speed N³. Input power also may increase significantly. In such applications use of High Efficiency Motors require careful application study.

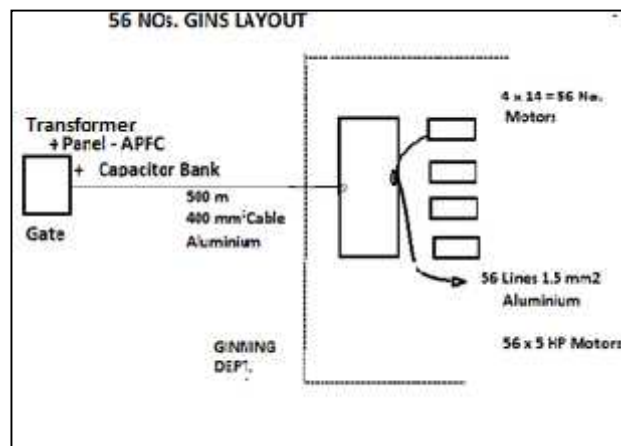
(c) High Starting Current

High efficiency motors also take significantly higher starting current (up to 900%). Motor protection especially for large inertia loads, conveyers, blowers require careful study.

10. Case Study of Energy Efficient Motors

Courtesy **Mr. Bharat Shah**, NEOPHASE MOTORS, Vadodara -390 010

- Industry – Cotton Ginning
- Rating – 5.7 kW, 4-Pole for Ginning Machine
- Standard Motor – Output – 3,200 Watts
Efficiency – 85%
Input – 3,765 Watts
- High Efficiency Motor -Output 3,200 Watts
Efficiency – 89%
Input – 3,586 Watts
Saving 169 Watts 8,000 hrs.
- 1,352 kWh Tariff Rs. 7.5/kWh
= 10,140 Rs.
- Standard Motor Price – Rs. 12,000
- High Efficiency Motor Price – Rs. 15,000
- Price difference of Rs. 3,000 is recovered in 0.295Yr. = 3.5 Months
- Additional Saving in Cable losses see Diagram



Standard Motor Cable Loss 56 Motors – 5,660W
 High Efficiency Motor Cable Loss – 4,152 W
 Saving – 1,508 Watts
 Standard Motor 7A x 56 Motors
 Main Cable Loss of 500M – 18,879 Watts
 High Efficiency Motor 6A x 56 Motors
 Main Cable Loss of 500M – 13,870 Watts
 Saving - 5,009 Watts
 Total Saving – 6,517 Watts = 6.51kW

For 8,000 Hrs./Yr. Saving = 52,080kWh
 = Rs. 3,90,600

Extra Price for 56 Motors

56 x Rs. 3,000 = Rs. 1,68,000

Energy Saving 56 Motors = 56 x 10,140 Rs.
 = Rs. 5,67,840

Cable Loss Saving = Rs. 3 90 600

Total = Rs. 9,58,440

Pay Back Period = $\frac{168000}{958440}$
 = 0.17Yr. = 2.1 Months

CHEMICAL PLANT, March-2019

- A Pump Driven by – 40HP Motor was replaced with - 30HP New Motor same pressure, flow
- Measured Power Saving – 1.15kW

11. Rewinding (Ref. No. 6)

Rewinding leads to significant loss of efficiency as can be seen by following case study. Ten new 15kW motors were independently tested and purposely damaged and sent to nine different repair companies

Efficiency loss varied from 0.3% to 3.4%

Results of tests carried out on 15kW motors rewound at nine different repair companies are given in Table No. 7

Table No.7

Motor	Efficiency Change %
1	-3.4
2	-0.9
3	-0.6
4	-0.3
5	-1.0
6	-0.7
7	-0.4
8	-0.9
9	-1.5
Average	-1.1

Every Failure even if repaired, generally reduces the overall reliability of Motor

- Core losses are higher because of high temperature & lamination damage.
- Higher copper losses for low copper fill.
- Higher frictional losses for universal fans

12. Payback period and Calculation (Ref. 6)

Table No. 8 showing payback in months for IE3 in place of IE2

4 Pole

Rating Kw	Pole	Frame	Efficiency		Difference in efficiency	Energy savings per annum in KWH	Energy savings per annum in INR*	Pay back period in months*
			IE2	IE3				
11	4	160ML	89.8%	91.4%	1.6%	1544	10807	5.5
15	4	160ML	90.6%	92.1%	1.5%	1941	13590	5.9
18.5	4	180ML	91.2%	92.6%	1.4%	2208	15457	6.2
22	4	180ML	91.6%	93.0%	1.4%	2603	18222	4.1
30	4	200ML	92.3%	93.6%	1.3%	3250	22752	4.4
37	4	225SM	92.7%	93.9%	1.2%	3673	25708	5.5
45	4	225SM	93.1%	94.2%	1.1%	4064	28447	6.4
55	4	250M	93.5%	94.6%	1.1%	4925	34473	7.6
75	4	280SM	94.0%	95.0%	1.0%	6047	42329	7.5
90	4	280SM	94.2%	95.2%	1.0%	7226	50581	7.3
110	4	315SM	94.5%	95.4%	0.9%	7907	55346	8.1
125	4	315SM	94.6%	95.5%	0.9%	8966	62761	8.0
132	4	315SM	94.7%	95.6%	0.9%	9448	66136	8.0
160	4	315ML	94.9%	95.8%	0.9%	11404	79829	7.7
200	4	315ML	95.1%	96.0%	0.9%	14190	99309	7.5

About Authors

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THE END