Government of India

Ministry of MSME

Action Plan Report on

Squirrel Cage Induction Motor

for Import Reduction and Promoting Domestic Manufacturing

in MSME Sector

MAY, 2021

Prepared by

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A. COMMERCIAL DETAILS

1. NIC Code

Division 27: Manufacture of electrical equipment

271 Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus

> 2710 Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus
> This class includes the manufacture of power, distribution, and specialty transformers; electric motors, generators and motor generator sets; switchgear and switchboard apparatus; relays and industrial controls. The electrical equipment in this class is for distribution level voltages.

This class excludes:

- manufacture of electronic component-type transformers and switches, see 2610

- manufacture of environmental controls and industrial process control instruments, see 2651

- manufacture of switches for electrical circuits, such as push button and snap switches, see - manufacture of starting motors and generators for internal combustion engines, see 2930

27103 Manufacture of electric motors (except internal combustion engine starting motors)

2. HSN Code

The Harmonized Commodity Description and Coding System – commonly known as the Harmonized System or HS - is an internationally standardized nomenclature for the description, classification and coding of goods. It is developed and maintained by the World Customs Organization (WCO), formerly known as the Customs Co-operation Council.

The HS provides a coding system that is based on a hierarchical structure, starting with the Section at the higher level and getting more specific at Chapter, heading and subheading levels. Chapters, headings and subheadings are coded according to their positions in the hierarchy.

An HS code can be sub-divided into the next lower level to provide greater detail and definition of a product than the higher level. The HS consists of around 1200 four-digit headings and 5000 six-digit subheadings, which are organized in 21 Sections and 97 Chapters, which theoretically cover all commodities in international trade. These headings and subheadings, along with the General Rules of Interpretation and Section and Chapter Notes comprise the legal text of the Harmonized System.

As the basic building-blocks of the HS, subheadings are identified by six-digit codes. A six digit subheading code comprises three parts which provide information on its three different levels of detail. The first two digits represent the Chapter in which the goods are classified, the next two digits identify the heading within the Chapter where the goods are described, and the last two digits represent the most detailed subdivisions of the HS.

For instance, the code 0102.10 indicates that it belongs to Chapter 01, under heading 0102. An undivided heading has a six-digit code ending in "00". An HS subheading at six-digit level is the most detailed level of the HS. However, in order to fulfill national needs, the HS Convention allows contracting parties to subdivide the HS classification into even more specific levels by inserting additional national codes.

For instance, it is common for many countries to use two additional digits for tariff duties and another two digits for more specificity in their trade statistics. These additional breakouts beyond the six-digit codes are referred to as national tariff lines, or national breakouts. It should however be stressed that different countries often create different breakouts and national codes under the same HS subheading, except for customs unions, which normally tend to use identical tariff structures.

The 8 digit HS Code for Squirrel Cage Induction Motor is 85015110, 85015210 and 85015310 since all three codes contain motors with different output ranges.

85015110- A.C., Squirrel cage induction motors, 3 phase type: of an output not exceeding 750 W.
85015210- A.C., Squirrel cage induction motors, 3 phase type: of an output exceeding 750 watts but not exceeding 75 kW.
85015310- A.C., Squirrel cage induction motors, 3 phase type: of an output exceeding 75 kW not exceeding 375 kW.

3. Existing clusters of the product

As per information received from Headquarters, as on date, there are no existing clusters of Squirrel Cage Induction Motors found in India.

4.Possibility to create cluster & Probable areas or the district where the product can be manufactured

The possibility to create clusters is a strategic decision wherein the influencing and deciding factors can be the following:

- Concentration/ Proximity of source of raw material suppliers.
- Concentration/ proximity to end-users or market
- Existing manufacturers
- Proximity to ancillary units involved in manufacturing of parts and components.

Based on these factors and the information available, it is proposed that the possibility of establishing clusters for Squirrel Cage Induction Motors may be explored in Coimbatore, Aurangabad, Faridabad, Gujarat, U.P., as there is a substantial presence of domestic manufacturers of pumps and motors in these places. Other than these places, wherever there is a presence of manufacturers of pumps and electrical motors, Squirrel cage induction Motor manufacturers may be set up in such places.

The following clusters can be considered for promoting and indulging them into manufacturing of Squirrel Cage Induction Motors: Electrical Cluster, Faridabad; Motor Rewinding Cluster, Faridabad; Indian Electrical & Electronics Manufacturers Association, Delhi; Crompton Greeves Electrical Switch Gears Mini Lean Clusters, Thane, Motors and Pumps, Coimbatore ; Ahmadabad A/C Motor, Ahmadabad; Ahmedabad Pumps, Ahmadabad; Rajkot Electric Motor, Rajkot; Jamnagar Pumps, Jamnagar; Mehsana Pumps, Mehsana.

Besides above, in Bidadi Industrial area, Bengaluru, Karnataka the focus sector is for automobiles, Heavy Engineering & FMCG. There is a policy by the Govt. of Karnataka to motivate manufacturing of electric vehicles in this area, thus, there is a possibility of establishing clusters for Squirrel Cage Induction Motors. ThervoykandigaiIndl. Park, Chennai is for the Auto ancillary, Power, Heavy Engineering sector. In GIDC Sanand Industrial Estate, Ahmedabad the Focus sectors are Engineering, Automobiles & ancillary units, Engineering plastics, Semiconductors, Electronics, Medical Devices. In Shendra MIDC, Mumbai focus Sectors are Engineering and Electronics. Hence, there is ample scope for promoting manufacturing of Squirrel Cage Induction Motors in these industrial areas.

5. Number of industries registered as MSME available in the manufacturing of the product

Since there is no exact code exclusively for Squirrel Cage Induction Motors, therefore, it is difficult to enlist the no. of MSMEs engaged in the production of Squirrel Cage Induction Motors. However, based on information available from Udyam Registration portal, the list of MSMEs engaged in the manufacturing of products falling under NIC Code 27103 is given below.

State	State Name	Micro	Small	Medium	Total
1	ANDHRA PRADESH	20	2	0	22
2	ARUNACHAL PRADESH	0	0	0	0
3	ASSAM	5	0	0	5
4	BIHAR	32	0	0	32
5	CHHATTISGARH	15	0	0	15
6	GOA	0	0	0	0
7	GUJARAT	223	40	6	269
8	HARYANA	72	21	3	96
9	HIMACHAL PRADESH	4	7	0	11
10	JHARKHAND	31	2	0	33
11	KARNATAKA	84	15	4	103
12	KERALA	15	0	0	15
13	MADHYA PRADESH	58	6	2	66
14	MAHARASHTRA	363	26	14	403
15	MANIPUR	2	0	0	2
16	MEGHALAYA	0	0	0	0
17	MIZORAM	0	0	0	0
18	NAGALAND	0	0	0	0
19	ODISHA	12	1	1	14
20	PUNJAB	71	7	1	79
21	RAJASTHAN	123	5	0	128
22	SIKKIM	0	0	0	0
23	TAMIL NADU	236	29	8	273

24	TELANGANA	39	4	0	43
25	TRIPURA	2	0	0	2
26	UTTAR PRADESH	109	5	3	117
27	UTTARAKHAND	7	1	0	8
28	WEST BENGAL	42	11	1	54
29	ANDAMAN AND NICOBAR ISLANDS	0	0	0	0
30	CHANDIGARH	5	0	0	5
31	DADAR AND NAGAR HAVELI	3	0	0	3
32	DAMAN AND DIU	0	0	0	0
33	DELHI	89	10	1	100
34	JAMMU AND KASHMIR	18	1	0	19
35	LADAKH	0	0	0	0
36	LAKSHADWEEP	0	0	0	0
37	PUDUCHERRY	2	0	0	2
Total		1682	193	44	1919

Source: www.udyamregistration.gov.in

6. **Number of industries available in large scale industries for Squirrel Cage Induction Motor**

(i)**Crompton Greaves Consumer Electricals Limited**, Equinox Business Park, 1st Floor, Tower 3, LBS Marg, Kurla (W), Mumbai 400070, Maharashtra

(ii)**RotomotivePowerdrives India Ltd.**

223, Napa Talpad, Gana-Borsad Road, Tal: Borsad, Anand-388560, Gujarat, India
+91 922 711 0010/20/30 Email - info@rotomotive.com.

(iii)**Bharat Bijlee Limited**,
Marketing Office: No. 2 MIDC Thane-Belapur Road, AiroliNavi Mumbai 400 708, T: +91 22 2763 7200 / +91 22 2760 0401, E-mail: motorlvsales@bharatbijlee.com.Registered Office: Electric Mansion 6th Floor AppasahebMaratheMarg, Prabhadevi Mumbai 400 025 India, T: +91 22 2430 6237 / 6375

(iv)**Oswal Pumps Ltd**.,

Oswal Estate, NH-1, Kutail Road, P.O. Kutail-132 037,
Distt. KARNAL (Haryana) INDIA
Ph.No. : +91-184-6616600(30 Lines) +91-1748-257701-04
E-mail : contact@oswalpumps.com
URL : http://oswalpumps.com, www.oswalpumps.co.in

(v) **Siemens Limited**
Birla Aurora, Level 21, Plot No. 1080,
Dr. Annie Besant Road, Worli,
Mumbai – 400030, Tel.: +91 (022) 39677000
Fax: +91 (022) 24362404

(vi) **Havells India Ltd.**
QRG Towers, 2D, Sector -126, Expressway, Noida - 201 304 (UP),
Ph. +91-120-3331000,
E-mail: marketing@havells.com, www.havells.com

(vii) **Kirloskar Electric Company Limited**
No.19, 2nd Main Road,
Peenya 1st Stage, Phase-1, Peenya,
Bangalore - 560 058, India.
Tel: +91-80-28397256
enq@hub.vrkec.com
http://www.kirloskar-electric.com/

(viii) **ABB Limited**
32, Industrial Area, Nit, Faridabad City, Faridabad- 121001, Haryana, India
Phone 0129-2567181

7. Data on imports for last three years

Globally, demand for the induction motor is being driven by its increasing usage owing to its economic cost and low maintenance and growing demand for electric vehicles. Hence countries like India are importing induction motors in general Squirrel cage induction motors in particular for meeting increasing industrial demand for manufacturing electrical appliances like Machine tools, Air compressors, Surgical pumps, Vacuum pumps, Domestic Flour mills, Diamond polishers, Pharma machinery, Packaging machinery, Centrifugal pumps and Industrial drives (e.g. to run conveyor belts), conveyors, reciprocating pumps, crushers, mixer, large refrigerating machines, large blowers and fans etc. **The data for imports presented below has been arrived at by summing the import values for HS Codes 85015110, 85015210 and 85015310.**

IMPORT (RS LAKHS) OF A.C. SQUIRREL CAGE INDUCTION MOTORS 3 PHASE TYPE

S.No.	Year	85015110	85015210	85015310	Total	Growth
1	2017-18	2038.46	6347.74	3835.42	12221.62	64.68
2	2018-19	2587.82	8931.44	3758.65	15277.91	25.01
3	2019-20	2181.01	8610.20	8082.28	18873.49	23.53
4	2020-2021 (Apr-Jan)	1563.04	9613.66	4285.65	15462.35	-4.36

Source: Export Import Data Bank, Ministry of Commerce, Govt. of India.

It can be observed from the yearly trend of imports that, from 2017-18 to 2018-19 the import of Squirrel cage induction motors has declined around 40%. After that the import is reducing gradually. In 2020-21(Apr-Jan), import is showing a negative growth.

TOP 10 IMPORT (RS LAKHS) SOURCES OF A.C. SQUIRREL CAGE INDUCTION MOTORS 3 PHASE TYPEDURING 2019-20

Sl. No.	Country	85015110	85015210	85015310	Total
1	CHINA P RP	146.14	4,435.34	1041.01	5622.49
2	GERMANY	1523.47	1,079.69	611.15	3214.31
3	JAPAN	57.9	85.23	1936.04	2079.17
4	KOREA RP	5.96	95.55	1572.18	1673.69
5	U S A	13.94	417.37	1065.93	1497.24
6	ITALY	286.95	137.54	883.37	1307.86
7	BRAZIL	21.85	945.06	109.06	1075.97
8	SWEDEN	0.79	580.5	1.23	582.52
9	NETHERLAND	1.33	231.76	164.65	397.74
10	TAIWAN	0	64.74	246.46	311.2

Source: Export Import Data Bank, Ministry of Commerce, Govt. of India.

Squirrel cage induction motors are majorly imported from China, Germany, Japan, Korea, USA, Italy, Brazil etc as it can be seen from the top 10 import sources during 2019-20.

A look at the data reveals that more than half the imports are of code 85015210, which is, A.C., Squirrel cage induction motors, 3 phase type: of an output exceeding 750 watts but not exceeding 75 kW. This category dominates more than half the total imports of squirrel cage induction motors. Thus, the best opportunities for domestic manufacturers are of motors in the middle range. This is also true of the world market as several research papers and studies underscore the existing market and demand in the range of 0.75-22 kW. In this range, there are relatively few specific requirements that could apply and, therefore, the motors in this range are also relatively standard. However, this range also boasts most competition, so its margins will be the lowest, particularly, in the world market.

A glance at the main import sources shows that China is the leading import source nation, however, Germany is the leader in Squirrel cage induction motors, 3 phase type: of an output not exceeding 750 watts.

This is in line with Germany's position in the world market, where it is one of the pioneers. Germany has remained an industrially-driven and advanced economy since the 19th Century and therefore, is placed quite ahead in the learning curve for most equipment and capital-intensive industries. Owing to the recent more frequent considerations of energy-efficiency in motors, constant innovations are also called for. Again, Germany has effectively met this requirement well due to its focus on limiting variety but focusing on quality and innovations.

China has been able to retain its position due to large-scale investments in plant and machinery, specialization as well as frequent merger and acquisitions with/of foreign companies. Therefore, from the perspective of a developing country, China is a very strong and price-competitive supplier, dominating supplies of AC motors in the world.

8. Data on exports for last three years

The data for exports presented below has been arrived at by summing the export values for HS Codes 85015110, 85015210 and 85015310.

The top export destinations of Squirrel cage induction motors during 2019-20 are Bangladesh, United Arab Emeritus, Japan, Saudi Arabia, China P RP, U S A, Russia, Spain, Nigeria, Indonesia.

EXPORT (RS LAKHS) OF A.C. SQUIRREL CAGE INDUCTION MOTORS 3 PHASE TYPE

S.No.	Year	85015110	85015210	85015310	Total	Growth
1	2017-18	1799.68	11379.73	20688.99	33868.40	49.01
2	2018-19	546.65	14427.60	17342.63	32316.88	-4.58
3	2019-20	933.16	19411.74	28874.06	49218.96	52.30
4	2020-2021 (Apr-Jan)	724.22	18003.08	20015.70	38743.00	-6.05

Source: Export Import Data Bank, Ministry of Commerce, Govt. of India.

A cursory glance at the exports shows that the total exports of the three categories combined are more than twice their imports and showing both upswing and downswing. A breakup of these brings to our notice that only Motors with output not exceeding 750 Watts have a negative trade balance. In the other two categories, India has managed to be net exporters with highest exports of category of motors with output exceeding 75 kW but not exceeding 375 kW. This shows that India has managed to get some competitive edge in this third category of motors. However, it was earlier mentioned that best opportunities lie in the second category of motors. Therefore, we need to focus on the second category as well. Manufacturers may be given some incentives or made aware of the demand and advantages of focusing on the middle category of motors.

TOP 10 EXPORTS (RS LAKHS) DESTINATION OF A.C. SQUIRREL CAGE INDUCTION MOTORS 3 PHASE TYPE DURING 2019-20

S.No.	Country	85015110	85015210	85015310	Total
1	BANGLADESH	41.89	451.97	3934.65	4428.51
2	U ARAB EMTS	7.75	2703.02	417.35	3128.12
3	JAPAN	4.87	128.24	2936.27	3069.38
4	SAUDI ARAB	6.42	2683.2	151.74	2841.36
5	CHINA P RP	75.01	87.6	2554.93	2717.54
6	U S A	15.06	864.61	1467.11	2346.78
7	RUSSIA	1.52	23.57	2103.91	2129.00
8	SPAIN	0	1298.8	687.82	1986.62
9	NIGERIA	10.75	765.96	1032.5	1809.21
10	INDONESIA	30.72	911.28	751.41	1693.41

Source: Export Import Data Bank, Ministry of Commerce, Govt. of India.

The above statistics shows that there is no commonality in demand among major export destinations of induction motors for India. In many countries, induction motors of output more than 75 kW but not exceeding 375 kW is the dominant category, however, some countries clearly have a revealed preference for the middle category of induction motors. Therefore, India needs to develop a strategy to focus on these two categories to give a boost to its exports.

9·Scope for number of units which can be established in future

The production of Squirrel Cage Induction Motor can be promoted under Atmanirbhar Bharat Abhiyan by giving them special incentive.

10·Demand in the domestic market

Looking to the volume of imports during last three years, it can be assessed that there is huge demand for Squirrel Cage Induction Motor across the country in various industries like Agro, Cement, Chemical, Construction, equipments, Fertilizer &Chem, Irrigation, Metal mining, Nuclear, OEM, Oil & Gas, Power, steel, Automotive, transportation. Its various industrial uses/applications are:

A. Machine tools
B. Air compressors
C. Surgical pumps
D. Vacuum pumps,
E. Domestic Flour mills
F. Diamond polishers
G. Pharma machinery
H. Packaging machinery
I. Centrifugal pumps
J. Industrial drives (e.g. to run conveyor belts) air compressor, conveyors, reciprocating pumps, crushers, mixer, large refrigerating machines Large blowers and fans
K. Hoists, elevators

India Electric Motors Market is driven by growing awareness towards energy conservation, surging acceptance of electric vehicles, and improving industrial infrastructure in the country. The market is further fuelled by the growing HVAC industry, rapid urbanization, and stringent regulations toward power consumption. Electric motors are attributable to nearly 30% of the power consumption in the industries. Manufacturers are continuously coming up with product innovation and improved technologies in motor drives. Product innovation and technological advancement such as energy-efficient motors with significant power saving capability have steered higher adoption of electric motors in recent years across several segments such as automotive, manufacturing, HVAC equipment, and home appliances in the country.

According to the latest report by IMARC Group, titled "Indian Induction Motor Market: Industry Trends, Share, Size, Growth, Opportunity and Forecast 2020-2025", the induction motor market size in India reached a strong growth in 2019. The rising demand for consumer

electronics, such as air conditioners, washing machines, dishwashers, etc., is currently driving the market for induction motors in India. With the introduction of numerous government initiatives, like the "Make in India" campaign, Smart City Mission, AMRUT, affordable housing, has expanded the manufacturing sector of the country. As a result, the increasing penetration of automated solutions to enhance industrial equipment mechanisms is also augmenting the market for induction motors in India. Furthermore, the implementation of stringent policies by the Indian government for reducing carbon footprints will continue to drive the demand for induction motors as they consume significantly lesser energy than conventional motors. As a result of these factors, the market is expected to exhibit moderate growth during the forecast period (2020-2025).

11. Demand in export market

Top 10 exporters of Electric motors; AC motors, multi-phase, in the World in year 2019 by value (USD MLN)

SL. NO.	COUNTRY	850151	850152	850153	TOTAL
1	Germany	809.6	1851.1	844.1	3504.9
2	European Union	606.3	1536.4	1096.1	3238.8
3	China	376.0	1155.5	532.0	2063.5
4	Japan	462.2	610.2	207.4	1279.8
5	United States	201.4	351.0	483.6	1036.0
6	Italy	184.4	528.3	116.8	829.5
7	Czech Republic	53.7	430.6	181.3	665.6
8	Mexico	63.6	376.2	166.6	606.4
9	France	198.9	249.7	119.7	568.3
10	Finland	5.3	102.0	354.0	461.3

Source: wits.worldbank.org

Germany, European Union, China, Japan, United States, Italy are the major exporter of multi-phase Electric AC motors in the year 2019. India exported multi-phase Electric AC motors worth of USD 112.60 MLN in 2019.

Top 10 importers of Electric motors; AC motors, multi-phase, in the World in year 2019 by value(USD MLN)

SL. NO.	COUNTRY	850151	850152	850153	TOTAL
1	United States	493.43	1282.21	659.76	2435.40
2	Germany	464.89	995.52	426.69	1887.10
3	European Union	306.25	726.14	330.84	1363.22
4	China	277.92	455.29	345.40	1078.61
5	Italy	197.43	521.23	150.05	868.71
6	Japan	126.56	359.12	104.72	590.39
7	Canada	79.61	184.48	181.72	445.81
8	Korea, Rep.	113.89	194.81	127.47	436.18
9	Russian Federation	55.58	220.67	159.45	435.71
10	Belgium	22.82	102.07	303.37	428.26

Source: wits.worldbank.org

Analysing the data available through WITS, World Bank, USA, Germany, EU, China are some of the biggest importers of induction motors in the world market. The global induction motor market size was around USD 15.3 billion in 2020. The market is further projected to grow at a CAGR of 9.5% over the forecast period of 2021-2026 to attain a value of USD 26.4 billion by 2026. (Expertmarketresearch.com)

However, India's share in total exports to these countries is very low. The demand is also majorly skewed towards the second category of induction motors. Therefore, by focusing on second category through improved production to bring down costs, improve quality and undertaking R&D to incorporate more energy-efficient techniques, India can greatly increase its exports of Squirrel cage induction motors. This focused approach and appropriate incentive mechanisms (mentioned later) can help substitute imports of these products as most of the raw materials required are available in the domestic market, a need to improvise the production techniques is however, warranted.

B. TECHNICAL DETAILS

1. **Sector in which the product is falling:** Electrical for Industrial usage

2. **End users of the product/sector:**

Squirrel cage induction motors are commonly used in many industrial applications. They are particularly suited for applications where the motor must maintain a constant speed, be self-starting, or there is a desire for low maintenance.
These motors are commonly used in:

- Centrifugal pumps
- Industrial drives (e.g. to run conveyor belts) air compressor, conveyors, reciprocating pumps, crushers, mixer, large refrigerating machines Large blowers and fans
- Machine tools
- Lathes and other turning equipment
- Printing machinery, flour mills
- Hoists, elevators

3. **Governing Indian Specification/Standard:**

IS – 325: 1996: Specifications for 3 phase induction motor

IS 900: 1992: Code of Practice for installation and maintenance of induction motors

IS 1231: 1974: Dimensions of three phase foot mounted AC induction motors

IS 1271: 2012: Thermal Evaluation and classification of electrical insulation

IS 2223: 1983: Dimensions of flange mounted AC induction motors

IS 2253: 1974: Designations for types of construction and mounting arrangements of rotating electrical machines

IS 2254: 1985: Dimensions of vertical shaft motors for pumps.

IS 2968: 1968: Dimensions of slide rails for electric motors

IS 3043: 1987: Code of practice for Earthing

IS 4029: 2010: Guide for testing three phase induction motors

IS 4691: 1985: Degree of protection provided by enclosures for rotating electrical machinery

IS 4722: 1992: Rotating electrical machines

IS 4728: 1975: Terminal Marking and direction of rotation for rotation electrical machinery.

IS 4889: 1968/IS 15999-2-1: Methods of determination of efficiency of rotating electrical machines

IS 6362: 1995: Designation of methods of cooling for rotating electrical machines

IS 7538: 1996: Three phase squirrel cage induction motors for centrifugal pumps for agricultural applications

IS 7816: 1975: Guide for testing insulation resistance of rotating machines

IS 8151: 1976: Single speed three phase induction motors for driving lifts

IS 8223: 1999: Dimensions and output series for rotating electrical machines

IS 8789: 1996: Value of performance characteristics for three phase induction motors.

IS 12065: 1987: Permissible limits of noise levels for rotating electrical machines

IS 12075: 2008: Mechanical vibration of rotating electrical machines, measurement, evaluation and limits of vibration severity

IS 12615: 2018: EnergyefficientInduction motors- three phase squirrel cage

IS 12802: 1989: Temperature rise measurement of rotating electrical machines

IS 13529: 1992: Guide on effects of unbalanced voltage on the performance of three phase induction motors

IS 13555: 1993: Guide for selection and application of three-phase AC induction motors for different types of driven equipment.

4. Governing International Standards:

IEC 34 1: Recommendations for Rotating Electrical Machines.

IEC 72 1: Recommendations, Dimensions & output rating of Electrical Machines-Foot Mounting.

IEC 72 2: Recommendations for the Dimensions and Output Rating of Electrical Motors-Flange Mounting.

British Standards

BS 3979: Dimensions of Electric Motors

BS 4999: Specification for general requirements for Rotating Electrical Machines.

BS 5000: Specifications for Rotating Electrical Machines.

5. Flow Process Chart of the manufacturing:

The steps involved in the manufacture of Electric motor are as follows:

(a) Stator Assembly

1. Stator body machining
2. Stator coil winding
3. Insulation of stator slots and insertion of stator coils
4. Impregnation of wound stator core
5. Mounting of wound stator core in stator body

(b) Rotor Assembly

1. Rotor shaft machining
2. Building of rotor core
3. Die-casting of rotor core
4. Mounting of die-casted rotor core or rotor shaft
5. Machining & dynamically balancing of Rotor assembly

(c) Machining of other parts

1. Machining of end shields
2. Machining of bearing covers
3. Machining of terminal covers

(d) Final assembly

1. Mounting of bearing, bearing covers and fan on assembled rotor
2. Placing of rotor in stator
3. Fitting of end shields
4. Fitting of all other parts and components.

(e) Testing

Each assembled motor is then tested for routine tests as per ISI specification No. IS: 12615-2018.

(f) Painting and packing

6. **Qualitative Parameters of the product:**

Sr. No.	Parameter	Range
01	Rating	Up to 350 KW
02	Enclosure	Totally Enclosed Fan Cooled (TEFC)
03	Mounting	Foot Mounting, Flange Mounting Face Mounting, Foot cum Flange Foot cum Face
04	Ambient Temperature/Temperature rise	50 Degree/70 Degree
05	Voltage Variation	415+/-10%
06	Frequency variation	50HZ +/-5%
07	Combined Variation	10 % (Absolute sum)
08	Frame Dimensions	As per IS 1231 & IS 2223
09	Insulation Class	Class F
10	Degree of protection	IP 55
11	Duty/Rating	S1/Continuous
12	Altitude	Max.of 1000 Meter
13	Connection	Star up to 2 HP/Delta above 2 HP
14	Direction of rotation	Bidirectional
15	Bearing	Antifriction ball bearing
16	Grease	Lithium Soap Base Grade II
17	Vibration level	As per IS 12075
18	Noise level	As per IS 12065
19	Over speed	120 % Syn. RPM for 2 Min.
20	Overload Capacity	Capable of withstanding 60% Overload for 15 sec
21	RPM	3000/1500/1000/750/600/500/375
22	Voltage	220-660 Volt AC

7. **Details of the product licenses to obtained:**

As per BIS specification IS 12615-2018. Energy Efficient Induction Motor- Three Phase Squirrel Cage (Quality Control) Order 2017 Dated 18th January, 2017 & amendment order dated 29th September, 2017.

8. **Equipment required for manufacturing of the product:**

B.	**MACHINERY & EQUIPMEMT:**
1	Heavy duty centre Lathe machine speeds semi Norton gear box, head stock fitted with tapper roller bearing, Bed Length 10 feet, Width of Bed 18", fitted with 3 HP Motor.
2	Heavy duty centre Lathe machine speeds semi Norton gear box, head stock fitted with tapper roller bearing, Length of Bed 6 Ft, Width of Bed 14", 1370 mm Bed (2 HP)
3	Universal Milling machine with 1 HP Motor, table size 30" x 7" with accessories
4	Automatic Cylindrical grinding machine, Grinding length-600 mm
5	Shaping machine 24" STROKE, 3HP Motor
6	Radial Drilling Machine 25mm capacity, 1 HP Motor
7	Double Ended Bench Grinder, Wheel Diameter-6"(0.25 HP)
8	Bench Drilling Machine 13 mm, Capacity (0.5 HP)
9	Horizontal Band Saw M/c 175 mm, capacity(1.0 HP)
10	Treadle Guillotine Shearing machine , Blade Size-1240 mm, Cutting Thickness-2mm, 3HP Motor
11	Dynamic Balancing Machine 50 Kg. Capacity
12	Portable Grinding m/c, 4"
13	Portable Drilling m/c
14	Hydraulic Building Power Press 20 Ton, 2 HP Motor
15	Pit type Electric Furnace (20 KW)
16	Die-Casting Attachments
17	Semi Automatic Coil Winding m/c
18	Motor winding baking oven, Temp, 200^{o} c, 500 Kgs Capacity
19	Vacuum Impregnation plant, 5 KW, 500 LPH
20	Travelling Trolley
21	Air Compressor with Spray Gun, (2 cyl. 2State, 1 HP)
22	Electric Chain Hoist With Electric Trolley, For Industrial, Capacity: 0-1 Ton

9. **Testing Facilities required for the product:**

All motors are tested as per IS12615- 2018

1	Insulation Tester 1000 VDC
2	Resistance Meter (Micro Ohm Meter)
3	HV Test Meter (5 KV)
4	Power Analyzer 80 Amps, Class of accuracy-0.2
5	Power Analyzer 80 Amps, Class of accuracy-0.5

6	Auto Transformer 3 Phase, 0-500 VAC, 40 Amps
7	Digital Temperature indicator
8	Tachometer Contact type
9	Tachometer non-Contact type
10	Hydraulic Dynamometer 50 HP
11	Digital Multi meter
12	Digital Clamp meter
13	Spring Balance 0-50 Kgs
14	Stop Watch
15	Torque Bench
16	Brake Drum 250 mm
17	Venire Caliper
18	Micro Meter

10. **The Technology existing for the manufacturing of the Product & Suggested modern technology for implementation in the Market:**

Historically, the motors sold (and used by end-users) in India have lower energy efficiencies (IE-1 or less) than the efficient products technologically available and manufactured. Based on estimation, 90- 95% of the current installed stock of motors is at IE1 & sub-IE1 levels. The issue of multiple rewinding in the service life of motor(s) further reduces the efficiency drastically. This results in more energy consumption, hence affects the competitiveness of any business entity.

Further, Department of Industrial Policy & Promotion (DIPP) has issued a Quality Control order requiring all imported and domestically manufactured motors to conform to the minimum IE2 class of efficiency as per the revised IS:12615 with effect from 01.01.2018. It is a great opportunity for the motor users to leapfrog to the readily available even higher technology like IE3 class of motors.

Over 70% of all electrical energy consumed in industries is used by the motors, hence improving the efficiency of electric motors can save energy as well as operating cost, which is more than its purchase cost. The New Standard IEC60034-30/IS12615:2018 defines and harmonizes worldwide the IE efficiencies classes for low-voltage three-phase cage Induction motors. The efficiencies required by the new standards can only be achieved by the increased use of active and higher quality of materials and more complexity production technique etc

The IE Efficiency classes defined as:

IE1-Standard Efficiency (Comparable to EFF2)
IE2-High Efficiency (Comparable to EFF1)
IE3 – Premium Efficiency

High efficiency can be seen in many ways: like the relation between output power and input absorbed power, or like a measure of the losses that born when converting the electric power in mechanical energy. From another perspective, high efficiency motors consume less energy to produce the same torque on the shaft. Basically, an high efficiency motor is the result of precise workings, lower frictions, a dynamically balanced rotor, smaller space between rotor and stator and of the use of better materials. The main factors for the design are based on the choice of the type of lamination sheets and windings with a greater coil number and a bigger diameter wire. Among all materials that compose a motor, laminations have the highest influence on performance Silicon Magnetic laminations The main advantages given by the adoption of silicon magnetic laminations are higher efficiency & better guarantees on the quality constancy, assured by tolerances reported in international norms.

By changing the rotor from die-cast aluminum to die-cast copper, there has been a dramatic reduction in the rotor, core, and stray-load losses of the copper rotor motor, compared to and energy efficient motors of similar rating. These gains are achieved while preserving performance characteristics, such as torque-speed performance and particularly locked rotor current. Although motors with copper cage rotors have been available in large horsepower ratings for a while, the die cast copper rotor motors are now appearing on the market due to significant improvements in the technology of the copper die-casting process. These improvements are enabling large scale production of motors with cast copper rotors. As expected, the copper rotor motors have tested at higher efficiencies than their corresponding cast aluminum counterparts. Copper rotors is one of several improvements that can be made to industrial motors however, it has been the most logical advancement for polyphase squirrel cage induction motors for years. At the current horsepower ratings where copper rotor motors are commercially available (1 – 20Hp), permanent magnet motors are also an opportunity for higher energy efficiency; however, they require electronic controls and are generally more expensive. Therefore, copper rotor motors, with their promise of higher efficiencies appear to be the appropriate advancement for the general industrial motor population.

Similar to the other rotating electrical machines, a three-phase induction motor also consists of Stator, Rotor, Shaft, Bearings, Cooling fans and End plates Electrical conductivity is a key operating parameter in determining which type of material to use in rotor conductors. Conductors of better conductivity result in more efficient transfer of electrical energy. Materials has good electrical conductivity are Silver, Copper, Gold & Aluminium. Since silver and copper are precious and costly materials and their property for carrying heavy current and high voltage never allows as a choice of conductor in electrical machines. So the obvious choice is either aluminium or copper.

Since, efficiency being the ratio of the amount of work produced to the amount of energy consumed. The motor losses are the difference between input and output powers, and can be classified into five categories:

1. Iron losses: magnetic losses occur in core laminations.

2. Stator copper losses due to current in stator winding.

3. Rotor copper losses due to current in rotor windings.

4. Windage and friction losses due to mechanical drag in bearing and fans.

5. Stray load losses.

In modern day the major challenge in designing the rotating machine are:

1. It should be Energy Efficient

2. It should be Economical to design

It is clear that the new challenge in machine design is to optimize the efficiency and manufacturing cost both. The best design will be obtained by the compromise of two main factors i.e. cost and performance, the two exerting opposing influences. Performance optimization means motor is high efficient, has low losses and low temperature rise during the operation. Where, the cost optimization means the overall manufacturing cost of the motor should be minimized.

Energy Efficient Motors:

An „Energy Efficient" Motor produces the same shaft output (H.P.), but absorbs less input power (KW) than a standard motor of same rating.

Efficiency = Output power / Input power

= (Input power – losses) / Input power

= 1 – (losses / Input power)

Energy efficient motors, also called premium or high efficiency motors. Motors qualify as energy efficient if they meet or exceed the efficiency level standards. In conventional design, the cost of a motor increases while attempting to reduce the losses. In simplest terms, energy-efficient electric motors are high-quality versions of standard motor products. There has to more use of active electric materials like steel laminations and copper.

Squirrel Cage Rotor design and technology:

The Squirrel cage rotors are manufactured by two ways:

1. Fabrication techniques 2. Die Cast techniques

A fabricated rotor is one in which the rotor bars are individually inserted and then shorted together on each end ring. The rotor bars may be aluminium, copper or the alloys of aluminium or copper. The end rings are usually the same material as the bars. Die casting is a process involving injecting molten metal at a high pressure into a mold or cavity (called a die) in order to manufacture a part quickly and repeatedly. Die casting is commonly used in high production volume applications to manufacture small or medium size parts. Hence, die casting is a cheaper manufacturing technique compared to fabrication technique because fabrication is time consuming, costs high labour and does not fit for industrial volume production requirements. Based on the choice of conducting material for rotor winding and the after development of manufacturing techniques, following types of rotors design exist for a squirrel cage induction motor:

1. Fabricated Copper Bar Rotor (CuBar)

2. Fabricated Aluminium Bar Rotor (AlBar)

3. Aluminium Die Cast Rotor (DAR)

4. Copper Die Cast Rotor (DCR)

Copper Die Cast Rotor (DCR) Technology:

For the three phase low voltage Induction motor, the used material for the cage rotors is aluminium because of lower price when compared to copper, which was convenient for the existing technological solutions. As it is known, the copper resistivity is lower than that of aluminium, and therefore the copper cage rotor losses decrease with the ratio of resistivity of copper to resistivity of aluminium.

Hence for the same current requirement, the substitution of copper for aluminium results in around 35 %reductions in copper losses. It helps in significant improvement in efficiency and reduction in temperature rise during the operation of motor which is loaded continuously for hours.

Die casting is a process involving injecting molten metal at a high pressure (1500 – 25000 psi) into a mold or cavity in order to manufacture a part quickly and repeatedly. Typically, die casting is done with low melting temperature metals, given their typically lower cost of processing. Occasionally, higher melting temperature metals such as ferrous alloys are also used in die casting, but this is rare given the higher processing costs.

DCR technology or DCR rotors are those in which conducting material is copper in place of aluminium and rotor is manufactured by Die casting method. The molten material is the copper and its alloys in place of traditional light weighted aluminium rotor. The previous challenges of die casting copper, which are higher temperatures and pressures compared with die casting aluminium, have been solved with the development of a die casting process using nickel base alloy die inserts operated at elevated temperature.

Benefits of Die Cast Rotor Technology:

Die cast copper rotors can provide advantages in three ways:

1. Improvement in motor energy efficiency in operation

2. Reduction in overall manufacturing cost

3. Reduction in motor weight

If motor redesign efforts are solely to improve efficiency, it is estimated that the new design with DCR could achieve 92.5% efficiency. This DCR motor creates a super-premium efficiency motor with an efficiency level higher than currently available motors. The superior conductivity of copper over aluminium, ensures reduction of motor losses by 14 – 23 % and rotor I2R losses by 29 – 41%, leading to improvement of the overall efficiency of the motor by at least 2% - 5 %, for the same slot design. Copper rotors reduce operating temperatures due to their lower 2R losses. Elevated temperatures accelerate degradation of the insulation on motors winding, eventually leading to failure. Although the cost of die-casting a copper rotor is higher than that of die-casting an aluminium rotor, the overall cost of the motor utilizing the copper rotor can be lower. Due to the higher efficiency of the copper rotor, the overall length of the rotor (and motor) can be decreased, while still matching the performance of a motor utilizing an aluminium rotor.

By keeping the main dimension and other design parameters constant, replacing copper in place of aluminium in die-cast rotors, the rotor winding resistance losses get decreased because of the higher conductivity of the copper and its alloy. It sure helps in improving the efficiency level and reduces the temperature rise of the motor during its operation. It is certainly the performance optimization of a standard efficient induction motor.

On the other hand when the performance parameters (i.e. losses, efficiency, temperature rise, output power etc.) remains constant and aluminium is replaced by copper in die cast rotor , the main dimensions (Overall length and stator bore diameter) can be decreased. It reduces the overall manufacturing cost and over all weight of the motor. It is certainly the cost optimization of the motor.

11. **Raw Material required and availability:**

1. Aluminum alloy
2. Cast Iron
3. Cold Rolled Non Grade Electrical Steel
4. Enamel covered winding copper wire
5. Ball Bearing
6. Lithium Soap Base Grade II Grease
7. Varnish Class-F

(1) **Cold Rolled Non Grade Electrical Steel**— used for motors, is also in short supply in the country. Against industry's current requirement of about 360,000 MT per annum, only about 170,000 MT is being produced in the country.

72251920 FLT-RLD PRDCTS OF SILICON ELCTRCL STEEL OTHR THAN GRAIN ORIENTED: COLD ROLLED
Import value in 2019-20 Rs1524.31crore, export Rs111.63 crore,
Reduction in import duty may be making import of steel cheaper.

https://economictimes.indiatimes.com/industry/indl-goods/svs/steel/reduction-in-duty-could-reduce-steel-prices-by-up-to-10-in-near-term-icra/articleshow/80711508.cms

Supplier-

- SAIL, Rourkela Steel Plant, Rourkela, 769011, Ph. 2510018, 2447527
- POSCO Electrical Steel India Pvt Ltd., Address: 706, World Trade Centre Pune, 1 - Kharadi, Opp. Eon Free Zone, MIDC, Knowledge Park, Pune, Maharashtra 411014 Phone: 02140 662 626
- Thysserkrupp Electrical Steel India Private limited, Address: 3rd Cross, No. 37, 3rd Phase, 4th Main Rd, behind Arvind Motors, Phase 3, Peenya, Bengaluru, Karnataka 560058, Phone: 080 2839 1654
- MI Electrical Steel Processing India Pvt. Ltd., Majrakath, Rajasthan 301020 Phone: 01494 679 000

(2) Commodity: 72015010 **Cast Iron**Unit: KGS
Export-Rs 36.91 lakh, Import -Rs 0.51 lakh during 2019-20
Supplier-

- Jatin Industries | CI Casting | Cast Iron Casting Manufacturer,Address: 87/2B, G I D C , Phase I, Vatva Industrial Estate, Vatva, Ahmedabad, Gujarat 382445, Phone: 079 2583 1425
- Vaarpu - Cast Iron Casting Supplier in India,Address: 60, Vaanagam Rd, Papanaickenpalayam, Venugopal Layout, Coimbatore, Tamil Nadu 641037, Phone: 098652 44430

(3) Commodity: 76012010 **Aluminium Ingots- Alloyed** Unit: KGS
Export Rs876.55 crore, Import-Rs.2204.38 during 2019-20.importing more

Aluminium imports have witnessed a huge surge in recent years primarily from China, ASEAN countries and Middle East having surplus aluminium capacity.

Aluminium Association of India (AAI), which claimed to be "the legitimate voice of the industry" comprising primary producers, downstream manufacturers, equipment & product manufacturers and end-users with over 160 members, said while "global aluminium demand is being driven by India and China, Indian aluminium production is in line with country's demand and capacity utilization in FY-19 was 89% with production of 3695 kt."
Since FY11, domestic aluminium consumption has increased by 80% from 2207 kt to 3972 kt, while total aluminium imports have increased by 164% from 878 kt to 2318 kt. Imports of aluminium scrap on which India is 100% import dependent has increased by 187% from 470 kt to 1349 kt, AAI said.

"Currently 60% of country's aluminium demand is being met through imports," AAI said adding, India has become a dumping ground of aluminium& scrap due to global trade war as US imposed 10% import duty on aluminium and China imposed 25% duty on US scrap resulting diversion of global scrap supply chain towards India," AAI said.

Supplier-

- NALCO, Nalco Nagar - 759145, Angul, Odisha, PH. 06764 - 220110
- Kamala Metachem, Kolkata, No. 3, British Indian Street, 3rd Floor, Room No. 3D, Beside Great Eastern Hotel, B.B.D. Bagh, Kolkata - 700069, West Bengal, India, Contact-08048718721
- GTR Aluminium PVT. LTD, Plot No. 33 - E, Veerasandra Industrial Area Anekal, Taluk, Bengaluru, Karnataka 560100, Contact- 096111 77616.
- Baheti Metal, A-2/3, L.R. Apartment, opp. Police Comm. office, Shahibag, Ahmedabad, Gujarat 380004, Contact-091792 56276

(4) Commodity: 85441110 **Winding Wire of Enamelled copper** Unit: MTR
Export- Rs. 205.21 crore, Import-Rs 253.42 crore during 2019-20. Import has declined compared to 2018-19 (Rs 346.83 crore).
Supplier-

- Khaitan Winding Wire, India Exchange Pl, Chitpur, Barabazar Market, Kolkata, West Bengal 700001, Phone: 033 2225 3846
- Imide Winding Wires(Copper and aluminium winding wire manufacturer),Alipur - Narela Rd, DSIDC Industrial Area, Narela, Delhi, 110040, Phone: 099119 99571.

(5) Commodity: 72042190 **Othr Wst and Scrap of Stainless Steel** Unit: KGS
Export- Rs43.63 crore, Import- Rs11,244.46crore during 2019-20.huge import

Supplier-

- Scan Steels LTD., Trishna Nirmalya Bhawan, Plot No. 516/1723/3991, 2nd Floor, Magnetic Chowk, Patia, Bhubaneswar, Odisha 751024, Phone: 0674 272 5564

- SMS group, Plot No. 70, Near Meenaji, Sector-A, Zone-D, Mancheswar Industrial Estate, Bhubaneswar, Odisha 751010, Phone: 0674 258 0720.

Other raw material is locally available

12. **Covering raw material standards Indian/International standards:**

Alumium Alloy: IS 10259: 1982

Ball Bearing- IS 6455: 2020 & IS 6456:1972

Grease Grade: IS 12203: 1999&IS 12203: 1999

CRNO- IS 648:2006

Enameled Windings Copper wire: IS 13730

Colors for Ready Mixed Paints and Enamels: IS 5: 2007

C. PROJECT REPORT

1. The detailed bankable Project Report

Introduction:
A three phase squirrel cage induction motor is based on the principle of electromagnetism. The names 'squirrel cage' assigned as the rotor – looks like a squirrel cage. This rotor is a cylindrical structure laminated with steel which is embedded with highly conductive metal (typically aluminum or copper bar). When an alternating current pass through the stator windings, a rotating magnetic field is produced. This induces a current in the rotor winding, which produces its own magnetic field. The interaction of the magnetic fields produced by the stator and rotor windings produces a torque on the squirrel cage rotor.

Squirrel Cage Induction Motor Working Principle:
When a 3 phase supply is given to the stator winding it sets up a rotating magnetic field in space. This rotating magnetic field has a speed which is known as the synchronous speed. This rotating magnetic field induces the voltage in rotor bars and hence short-circuit currents start flowing in the rotor bars. These rotor currents generate their self-magnetic field which will interact with the field of the stator. Now the rotor field will try to oppose its cause, and hence rotor starts following the rotating magnetic field. The moment rotor catches the rotating magnetic field the rotor current drops to zero as there is no more relative motion between the rotating magnetic field and rotor. Hence, at that moment the rotor experiences zero tangential force hence the rotor decelerates for the moment. After deceleration of the rotor, the relative motion between the rotor and the rotating magnetic field re-establishes hence rotor current again being induced. So again, the tangential force for rotation of the rotor is restored, and therefore again the rotor starts following rotating magnetic field, and in this way, the rotor maintains a constant speed which is just less than the speed of rotating magnetic field or synchronous speed. Slip is a measure of the difference between the speed of the rotating magnetic field and rotor speed. The frequency of the rotor current = slip × supply frequency

Squirrel Cage Induction Motor Construction
A squirrel cage induction motor consists of the following parts:

- Stator
- Rotor
- Fan
- Bearings

Stator
It consists of a 3 phase winding with a core and metal housing. Windings are such placed that they are electrically and mechanically 120^{o} apart from in space. The winding is mounted on the laminated iron core to provide low reluctance path for generated flux by AC currents.

Rotor
It is the part of the motor which will be in a rotation to give mechanical output for a given amount of electrical energy. The rated output of the motor is mentioned on the nameplate in horsepower. It consists of a shaft, short-circuited aluminum bars, and a core. The rotor core is laminated to avoid power loss from eddy currents and hysteresis. Conductors are skewed to prevent cogging during starting operation and gives better transformation ratio between stator and rotor.

Fan
A fan is attached to the back side of the rotor to provide heat exchange, and hence it maintains the temperature of the motor under a limit.

Bearings
Bearings are provided as the base for rotor motion, and the bearings keep the smooth rotation of the motor.

Application of Squirrel Cage Induction Motor
Squirrel cage induction motors are commonly used in many industrial applications. They are particularly suited for applications where the motor must maintain a constant speed is self-starting, or there is a desire for low maintenance.

These motors are commonly used in:

- Centrifugal pumps
- Industrial drives (e.g. to run conveyor belts)
- Large blowers and fans
- Machine tools
- Lathes and other turning equipment

Advantages of Squirrel Cage Induction Motor
Some advantages of squirrel cage induction motors are:

- They are low cost
- Require less maintenance (as there are no slip rings or brushes)
- Good speed regulation (they are able to maintain a constant speed)
- High efficiency in converting electrical energy to mechanical energy (while running, not during startup)
- Have better heat regulation (i.e. don't get as hot)
- Small and lightweight
- Explosion proof (as there are no brushes which eliminate the risks of sparking)
-

Classification of Squirrel Cage Induction Motor:
Design of the squirrel cage induction motors based on their speed-torque characteristics into some classes. These classes are Class A, Class B, Class C, Class D, Class E and Class F.

Class A Design
1. A normal starting torque.
2. A normal starting current.
3. Low slip.
4. In this Class, pullout torque is always of 200 to 300 percent of the full-load torque and it occurs at a low slip (it is less than 20 percent).
5. For this Class, the starting torque is equal to rated torque for larger motors and is about 200 percent or more of the rated torque for the smaller motors.

Class B Design
1. Normal starting torque,
2. Lower starting current,

3. Low slip.
4. Induction Motor of this class produces about the same starting torque as the class A induction motor.
5. Pullout torque is always greater than or equal to 200 percent of the rated load torque. But it is less than that of the class A design because it has increased rotor reactance.
6. Again Rotor slip is still relatively low (less than 5 percent) at full load.
7. Applications of Class B design are similar to those for design A. But design B is preferred more because of its lower starting-current requirements.

Class C Design

1. High starting torque.
2. Low starting currents.
3. Low slip at the full load (less than 5 %).
4. Up to 250 percent of the full-load torque, the starting torque is in this class of design.
5. The pullout torque is lower than that for Class A induction motors.
6. In this design the motors are built from double-cage rotors. They are more expensive than motors of Class A and B classes.
7. Class C Designs are used for high-starting-torque loads (loaded pumps, compressors, and conveyors).

Class D Design

1. In this Design of Class motors has very high starting torque (275 percent or more of the rated torque).
2. A low starting current.
3. A high slip at full load.
4. Again in this class of design the high rotor resistance shifts the peak torque to a very low speed.
5. It is even possible at zero speed (100 percent slip) for the highest torque to occur in this class of design.
6. Full-load slip (It is typically 7 to 11 percent, but may go as high as 17 percent or more) in this class of design is quite high because of the high rotor resistance always.

Class E Design

1. Very Low Starting Torque.
2. Normal Starting Current.
3. Low Slip.
4. Compensator or resistance starter are used to control starting current.

Class F Design

1. Low Starting Torque, 1.25 times of full load torque when full voltage is applied.
2. Low Starting Current.
3. Normal Slip.

There are different kinds and ratings and this project envisages manufacturing of squirrel cage induction motor up to 10 HP.

Market Demand:

Looking to the volume of imports during last three years, it can be assessed that there is huge demand for Squirrel Cage Induction Motor across the country in various industries like Agro, Cement, Chemical, Construction, equipments, Fertilizer & Chemical, Irrigation,

Metal mining, Nuclear, OEM, Oil & Gas, Power, steel, Automotive, transportation. Its various industrial uses/applications are:

A. Machine tools
B. Air compressors
C. Surgical pumps
D. Vacuum pumps,
E. Domestic Flour mills
F. Diamond polishers
G. Pharma machinery
H. Packaging machinery
I. Centrifugal pumps
J. Industrial drives (e.g. to run conveyor belts) air compressor, conveyors, reciprocating pumps, crushers, mixer, large refrigerating machines Large blowers and fans
K. Hoists, elevators

India Electric Motors Market is driven by growing awareness towards energy conservation, surging acceptance of electric vehicles, and improving industrial infrastructure in the country. The market is further fuelled by the growing HVAC industry, rapid urbanization, and stringent regulations toward power consumption. *Electric motors* are attributable to nearly 30% of the power consumption in the industries. Manufacturers are continuously coming up with product innovation and improved technologies in motor drives. Product innovation and technological advancement such as energy-efficient motors with significant power saving capability have steered higher adoption of electric motors in recent years across several segments such as automotive, manufacturing, HVAC equipment, and home appliances in the country.

According to the latest report by IMARC Group, titled "Indian Induction Motor Market: Industry Trends, Share, Size, Growth, Opportunity and Forecast 2020-2025", the induction motor market size in India reached a strong growth in 2019. The rising demand for consumer electronics, such as air conditioners, washing machines, dishwashers, etc., is currently driving the market for induction motors in India. With the introduction of numerous government initiatives, like the "Make in India" campaign, Smart City Mission, AMRUT, affordable housing, has expanded the manufacturing sector of the country. As a result, the increasing penetration of automated solutions to enhance industrial equipment mechanisms is also augmenting the market for induction motors in India. Furthermore, the implementation of stringent policies by the Indian government for reducing carbon footprints will continue to drive the demand for induction motors as they consume significantly lesser energy than conventional motors. As a result of these factors, the market is expected to exhibit moderate growth during the forecast period (2020-2025).

Basis & Presumptions

1. The Detail Project Report (DPR) is prepared on the basis of single shift working hour and 300 days per annum with 60% efficiency in the first year.
2. BEP for the scheme has been calculated in 5 years with 60% efficiency to 90% efficiency.
3. Rate of interest has been taken as 10% on an average. This however, is likely to vary depending upon the financial outlay and the location of the unit.
4. Minimum labour wages have been taken into account.

5. 25% margin money has to be contributed by the entrepreneur and 75% of the project cost will be availed from financial institution/bank.
6. The costs of machinery and equipment as indicated in the scheme are approximate to the present market price at the time of preparation of the DPR. The entrepreneur may check up the exact price for specific make and model of the machine selected.
7. Non-refundable deposits, cost of preparation of project report etc. may be considered under pre-operative expenses.
8. The cost of raw materials, utilities, overheads etc. is drawn on the basis of local price which may vary time to time.
9. The operative period of this project is estimated to be about 10 years considering technology obsolescence.
10. 10% of the production after warranty period will be provided services for minor repair and maintenance and service charge will be collected from the customers.

Implementation schedule

The period required from the time of time of filling to MSME department of the state to commercial production is 6 months.

TECHNICAL ASPECTS:

Manufacturing Process

The steps involved in the manufacture of Electric motor are as follows:

(a) Stator Assembly

- Stator body machining
- Stator coil winding
- Insulation of stator slots and insertion of stator coils
- Impregnation of wound stator core
- Mounting of wound stator core in stator body

(b) Rotor Assembly

- Rotor shaft machining
- Building of rotor core
- Die-casting of rotor core
- Mounting of die-casted rotor core or rotor shaft
- Machining & dynamically balancing of Rotor assembly

(c) Machining of other parts

- Machining of end shields
- Machining of bearing covers
- Machining of terminal covers

(d) Final assembly

- Mounting of bearing, bearing covers and fan on assembled rotor
- Placing of rotor in stator
- Fitting of end shields
- Fitting of all other parts and components.

(e) Testing

Each assembled motor is then tested for routine tests as per ISI specification No. IS: 12615-2018.

(f) Painting and packing

Quality control & standards

Each assembled motor is tested for routine tests as per ISI specification No. IS:12615-2018.

Production capacity

Quantity	: 6,000 Electric Motors
Value	: Rs. 4,92,00,000.00
Service charges on repair & maintenance Maintenance of 600 Nos. 5 H.P. Squirrel Cage Induction Motor	: Rs. 9,00,000.00

Motive Power Requirement: 75 KW

Pollution Control Requirement:

In the manufacturing of electric motors there is no serious pollution hazard. The workers must be provided with face shield / mask during operations.

Energy Conservation Requirement:

The design of Electric motors should ensure minimum magnetic and copper loss. Optimal use of man and machine will save energy.

	FINANCIAL ASPECTS	Qty.	Rate / price	Total Amount
	Fixed Capital:			
A.	**Land & Building:**			
1	Land	5000sqft		Own
2	Shed	3000sqft	@Rs. 400.00/sqft	Rs. 12,00,000.00
B.	**Machinery and Equipment:**	Qty. in Nos.	Rate / price	Total Amount
1	Heavy duty centre Lathe machine speeds semi Norton gear box, head stock fitted with tapper roller bearing, Bed Length 10 feet, Width of Bed 18", fitted with 3 HP Motor.	2	Rs. 2,98,000.00	Rs. 5,96,000.00
2	Heavy duty centre Lathe machine speeds semi Norton gear box, head stock fitted with tapper roller bearing, Length of Bed 6 Ft, Width of Bed 14", 1370 mm Bed (2 HP)	2	Rs. 1,60,000.00	Rs. 3,20,000.00
3	Universal Milling machine with 1 HP Motor, table size 30" x 7" with accessories	1	Rs. 95,000.00	Rs. 95,000.00
4	Automatic Cylindrical grinding machine, Grinding length-600	1	Rs. 3,50,000.00	Rs. 3,50,000.00

	mm			
5	Shaping machine 24" STROKE, 3HP Motor	1	Rs. 1,98,000.00	Rs. 1,98,000.00
6	Radial Drilling Machine 25mm capacity, 1 HP Motor	1	Rs. 88,000.00	Rs. 88,000.00
7	Double Ended Bench Grinder, Wheel Diameter-6"(0.25 HP)	1	Rs. 7,500.00	Rs. 7,500.00
8	Bench Drilling Machine 13 mm Capacity (0.5 HP)	1	Rs. 15,500.00	Rs. 15,500.00
9	Horizontal Band Saw M/c 175 mm capacity(1.0 HP)	1	Rs. 98,000.00	Rs. 98,000.00
10	Treadle Guillotine Shearing machine Blade Size-1240 mm, Cutting Thickness-2mm, 3HP Motor	1	Rs. 248,000.00	Rs. 248,000.00
11	Dynamic Balancing Machine 50 Kg. Capacity	1	Rs. 100,000.00	Rs. 100,000.00
12	Portable Grinding m/c, 4"	1	Rs. 2,500.00	Rs. 2,500.00
13	Portable Drilling m/c	1	Rs. 2,000.00	Rs. 2,000.00
14	Hydraulic Building Power Press 20 Ton, 2 HP Motor	1	Rs. 1,78,000.00	Rs. 1,78,000.00
15	Pit type Electric Furnace (20 KW)	1	Rs. 1,30,000.00	Rs. 1,30,000.00
16	Die-Casting Attachments	1	Rs. 30,000.00	Rs. 30,000.00
17	Semi Automatic Coil Winding m/c	1	Rs. 1,20,000.00	Rs. 1,20,000.00
18	Motor winding baking oven, Temp, 200° c, 500 Kgs Capacity	2	Rs. 1,10,000.00	Rs. 2,20,000.00
19	Vacuum Impregnation plant, 5 KW, 500 LPH	1	Rs. 3,00,000.00	Rs. 3,00,000.00
20	Travelling Trolley	1	Rs. 15,000.00	Rs. 15,000.00
21	Air Compressor with Spray Gun (2 cyl. 2State, 1 HP)	1	Rs. 25,800.00	Rs. 25,800.00
22	Electric Chain Hoist With Electric Trolley, For Industrial, Capacity: 0-1 Ton	1	Rs. 65,000.00	Rs. 65,000.00
23	Insulation Tester 1000 VDC	2	Rs. 4,500.00	Rs. 9,000.00
24	Resistance Meter (Micro Ohm Meter)	2	Rs. 6,000.00	Rs. 12,000.00
25	HV Test Meter (5 KV)	2	Rs. 20,000.00	Rs. 40,000.00

26	Power Analyzer 80 Amps, Class of accuracy-0.2	1	Rs. 2,50,000.00	Rs. 2,50,000.00
27	Power Analyzer 80 Amps, Class of accuracy-0.5	1	Rs. 1,25,000.00	Rs. 1,25,000.00
28	Auto Transformer 3 Phase, 0-500 VAC, 40 Amps	2	Rs. 70,000.00	Rs. 1,40,000.00
29	Digital Temperature indicator	2	Rs. 3,500.00	Rs. 7,000.00
30	Tachometer Contact type	1	Rs. 2,000.00	Rs. 2,000.00
31	Tachometer non-Contact type	1	Rs. 2,500.00	Rs. 2,500.00
32	Hydraulic Dynamometer 50 HP	1	Rs. 2,00,000.00	Rs. 2,00,000.00
33	Digital Multi meter	2	Rs. 2,000.00	Rs. 4,000.00
34	Digital Clamp meter	2	Rs. 2,500.00	Rs. 5,000.00
35	Spring Balance 0-50 Kgs	1	Rs. 8,000.00	Rs. 8,000.00
36	Stop Watch	1	Rs. 4,500.00	Rs. 4,500.00
37	Torque Bench	1	Rs. 5,000.00	Rs. 5,000.00
38	Brake Drum 250 mm	2	Rs. 2,000.00	Rs. 4,000.00
39	Venire Caliper	5	Rs. 4,000.00	Rs. 20,000.00
40	Micro Meter	5	Rs. 5,000.00	Rs. 25,000.00
			Total	**Rs. 40,67,300.00**
41	GST 18%			Rs. 7,32,114.00
42	Installation & electrification charges @10%			Rs. 4,06,730.00
43	Freight with insurance charges @5%			Rs. 2,03,365.00
44	Office furniture like chair, table, fan, almirah, computer set etc	L.S		Rs. 1,50,000.00
			G.TOTAL	**Rs. 55,59,509.00**
C.	**Preoperative Expenses:**			
1	Preparation of DPR			Rs. 10,000.00
2	Travelling expenses			Rs. 10,000.00
3	Local trade license & GST registration exp.			Rs. 10,000.00
4	Publicity/advertisement exp.			Rs. 10,000.00
5	Other misc. expenses			Rs. 10,000.00
			Total	Rs. 50,000.00
	Total Capital Investment			**Rs. 68,09,509.00**
D.	**Working Capital (P.M.)**			
I	**Raw Material: To prepare 500 nos. of 5 H.P motor**			

Sl. no.	Particulars	Qty. in kg/pc/ltr.	Rate/Kg/ltr./pair	Total Amount in Rs.
1	Castings	12,500 kg	Rs. 40.00	Rs. 5,00,000.00
2	Shafting	2,500 kg	Rs. 130.00	Rs. 3,25,000.00
3	Stampings	9,000 kg	Rs. 100.00	Rs. 9,00,000.00
4	Enamelled Copper Wires	1,750 kg	Rs. 500.00	Rs. 8,75,000.00
5	Fan and Fan cover	500 Pair	Rs. 100.00	Rs. 50,000.00
6	Bearings	1,000 Pc	Rs. 350.00	Rs. 3,50,000.00
7	EC grade Aluminium	900 kg	Rs. 165.00	Rs. 1,48,500.00
8	Paint Thinner, Primer etc. Kg	300 kg	Rs. 150.00	Rs. 45,000.00
9	Varnishes	100 ltr.	Rs. 140.00	Rs. 14,000.00
10	Thinner	40 ltr.	Rs. 90.00	Rs. 3,600.00
11	Insulating material	L.S		Rs. 25,000.00
12	Hardware	L.S		Rs. 20,000.00
13	Miscellaneous Materials	L.S		Rs. 10,000.00
14	Packing Materials	L.S		Rs. 50,000.00
			Total	**Rs. 33,16,100.00**
II	**Salary and Wages**			
Sl. No.	Personnel	Qty. in no. of person	Salary/month	Total Amount
1	Manager	1	Rs. 30,000.00	Rs. 30,000.00
2	Technician	2	Rs. 20,000.00	Rs. 40,000.00
3	Skilled worker	10	Rs. 15,000.00	Rs. 1,50,000.00
4	Un skilled worker	5	Rs. 10,000.00	Rs. 50,000.00
5	Store keeper cum accountant	1	Rs. 20,000.00	Rs. 20,000.00
6	Watchman/peon	2	Rs. 10,000.00	Rs. 20,000.00
			Total	**Rs. 3,10,000.00**
III	**Utility**	Units	price/unit	Total amount
1	Electricity 75 kw	9000	Rs. 7.00	Rs. 63,000.00
IV	**Other Overhead Expenses:**			
1	Internet & telephone charges			Rs. 1,000.00
2	Traveling & transport expenses			Rs. 15,000.00
3	Office stationery			Rs. 1,000.00
4	Sale Expenses			Rs. 4,000.00
5	Publicity expenses			Rs. 1,000.00
			Total	**Rs. 22,000.00**

FINANCIAL ANALYSIS FOR SEVEN YEARS

ESTIMATED COST OF PRODUCTION (Rs. In lakhs) Installed Capacity:10,000 Nos. of 5 H.P. Squirrel Cage Induction Motor							
HEAD	YEAR						
	1	2	3	4	5	6	7
Capacity Utilization %	**60%**	**60%**	**70%**	**70%**	**80%**	**80%**	**90%**
PRODUCTION (Nos)	6,000	6,000	7,000	7,000	8,000	8,000	9,000
COST OF PRODUCTION							
Raw Materials value	397.93	397.93	437.72	437.72	481.49	481.49	529.64
Direct Labour (Salaries)	37.2	37.2	40.92	40.92	45.01	45.01	49.51
Repair and Maintenance							
a) 2% of Plant & Machinery	0.81	0.81	0.89	0.89	0.98	0.98	1.08
b) 2% of miscellaneous fixed sets	0.03	0.03	0.03	0.03	0.03	0.03	0.03
c) 2% of Building	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Utilities (increase by 10%)	7.56	7.56	8.32	8.32	9.15	9.15	10.06
TOTAL COST OF PRODUCTION	**443.77**	**443.77**	**488.12**	**488.12**	**536.9**	**536.9**	**590.56**

STATEMENT OF PROFITABILITY (Rs. In lakhs)								
Sl. No.	**HEAD**	**YEAR**						
		1	2	3	4	5	6	7
1	Sales	501	501	584.5	584.5	668	668	751.5
	Less: Cost of Production	443.77	443.77	488.12	488.12	536.9	536.9	590.56
	Less: Administrative Expenses	2.64	2.64	2.9	2.9	3.19	3.19	3.51
	Less: Interest on working capital loan	4.19	4.19	4.6	4.6	5.06	5.06	5.57
2	**PBDIT**	**50.4**	**50.4**	**88.88**	**88.88**	**122.85**	**122.85**	**151.86**
	Less: Interest on term loan	5.42	4.75	3.8	2.85	1.9	0.95	0
	Less: Depreciation	8.31	6.86	5.67	4.72	3.92	3.28	2.74
	PBDT	36.67	38.79	79.41	81.31	117.03	118.62	149.12
	Less: Tax @15% (see tax table)	5.72	5.97	12.00	12.25	17.58	17.80	22.36
3	**PAT**	30.95	32.82	67.41	69.06	99.45	100.82	126.76
	CASH PROFIT							
	Retained	30.95	32.82	67.41	69.06	99.45	100.82	126.76
	add: Depreciation as per Company Act	8.31	6.86	5.67	4.72	3.92	3.28	2.74
	Cash Profit	39.26	39.68	73.08	73.78	103.37	104.1	129.5

PROJECTED CASH FLOW STATEMENT (Rs. in lakhs)								
HEAD	**YEAR**							
	0	1	2	3	4	5	6	7
Sources of Fund								
Equity	19.79							
Term loan	57							
PBDIT		50.4	50.4	88.88	88.88	122.85	122.85	151.86
Working Capital loan		41.85	0	4.18	0	4.6	0	5.06
Total (A)	**76.79**	**92.25**	**50.4**	**93.06**	**88.88**	**127.45**	**122.85**	**156.92**
APPLICATION OF FUNDS								
Shed	12							
Plant & machinery	50.10							
Furniture	1.5							
Preoperative exp.	0.5							
Total working capital	0	55.8	0	5.58	0	6.13	0	6.75
Interest on term loan	0	5.42	4.75	3.8	2.85	1.9	0.95	0
Interest on working capital loan		4.19	4.19	4.6	4.6	5.06	5.06	5.57
Loan repayment	0	7	10	10	10	10	10	0
Tax	0	5.72	5.97	12	12.25	17.58	17.8	22.36
Total (B)	**64.095**	**78.13**	**24.91**	**35.98**	**29.7**	**40.67**	**33.81**	**34.68**
Opening cash in hand	0	12.69	26.81	52.3	109.38	168.56	255.34	344.38
Net cash flow(A-B)	12.69	14.12	25.49	57.08	59.18	86.78	89.04	122.24
Closing cash in hand/bank	12.69	26.81	52.3	109.38	168.56	255.34	344.38	466.62

NOTE: Pay Back Period of term loan in Six Years

BALANCE SHEET (Rs. in Lakhs)								
HEAD		**YEAR**						
Sources of fund	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PAT (cumulative)	0	30.95	63.77	131.18	200.24	299.69	400.51	527.27
Equity	19.79	19.76	19.76	19.76	19.76	19.76	19.76	19.76
Term loan	57	57.00	57.00	57.00	57.00	57.00	57.00	57.00
Working capital loan	0	41.85	41.85	46.03	46.03	50.63	50.63	55.69
Total	**76.79**	**149.56**	**182.38**	**253.97**	**323.03**	**427.08**	**527.90**	**659.72**
Application of fund								
Gross block	63.6	63.6	63.6	63.6	63.6	63.6	63.6	63.6
Depreciation	0	8.31	15.17	20.84	25.56	29.48	32.76	35.5
Net block	63.6	55.29	48.43	42.76	38.04	34.12	30.84	28.1
Net current asset (Working capital)	0	55.8	55.8	61.38	61.38	67.51	67.51	74.26
Preoperative W/O	0.5	0.4	0.3	0.2	0.1	0	0	0
Cash in hand	12.69	26.81	52.3	109.38	168.56	255.34	344.38	466.62
Bills receivable	0	11.26	25.55	40.25	54.95	70.11	85.17	90.74
Total	**76.79**	**149.56**	**182.38**	**253.97**	**323.03**	**427.08**	**527.9**	**659.72**

CALCULATION OF DEPRECIATION (As per Company Act) (Rs. In lakhs)									
HEAD	Gross Value in Lakh	Rate of Depreciation	YEAR						
			1	2	3	4	5	6	7
Building	12	5% WDV	0.6 11.4	0.57 10.83	0.54 10.39	0.52 9.87	0.49 9.38	0.47 8.91	0.45 8.46
Plant & Machinery	40.673	18.00%	7.32 33.36	6.00 27.36	4.92 22.44	4.04 18.4	3.31 15.09	2.72 12.37	2.23 10.14
Furniture	1.5	26%	0.39 1.11	0.29 0.82	0.21 0.61	0.16 0.45	0.12 0.33	0.09 0.24	0.06 0.18
TOTAL			**8.31**	**6.86**	**5.67**	**4.72**	**3.92**	**3.28**	**2.74**
CALCULATION OF DEPRECIATION (As per Income Tax Act)									
HEAD	Gross Value in Lakh	Rate of Depreciation	YEAR						
			1	2	3	4	5	6	7
Building	12	5% WDV	0.6 11.4	0.57 10.83	0.54 10.29	0.51 9.78	0.49 9.29	0.46 8.83	0.44 8.39
Plant & Machinery	40.673	15%	6.10 34.57	5.18 29.39	4.41 24.98	3.74 21.24	3.18 18.06	2.71 15.35	2.30 13.05
Furniture	1.5	10%	0.15 1.35	0.13 1.22	0.12 1.10	0.11 0.99	0.09 0.90	0.09 0.81	0.08 0.73
TOTAL			**6.85**	**5.88**	**5.07**	**4.36**	**3.76**	**3.26**	**2.82**

INTEREST CALCULATION FOR TERM LOAN (Rs. in Lakhs)							
Total loan amount:	57						
Rate of interest:	9.50%						
Repayment in no. of years:	6						
Moratorium:	1						
HEAD	**YEAR**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Debt							
Term loan	**57**	57	50	40	30	20	10
Loan repayment	**0**	**7**	**10**	**10**	**10**	**10**	**10**
Outstanding loan	57	50	40	30	20	10	0
Interest on term loan (9.5%)	5.42	4.75	3.8	2.85	1.9	0.95	0

WORKING CAPITAL REQUIREMENT (Rs. in Lakhs)							
HEAD	**YEAR**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Cost of Production	443.77	443.77	488.12	488.12	536.9	536.9	590.56
Administrative Overhead	2.64	2.64	2.9	2.9	3.19	3.19	3.51
Total requirement for the year	**446.41**	**446.41**	**491.02**	**491.02**	**540.09**	**540.09**	**594.07**
Working capital requirement for 1.5 months	55.80	55.80	61.38	61.38	67.51	67.51	74.26
Working capital loan (75%)	41.85	41.85	46.03	46.03	50.63	50.63	55.69
Interest on working capital(10%)	4.19	4.19	4.60	4.60	5.06	5.06	5.57

TAX Details (Rs. In Lakhs)							
HEAD	**YEAR**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
PBDT	36.67	38.79	79.41	81.31	117.03	118.62	149.12
add: Depreciation as per company Act	**8.31**	6.86	5.67	4.72	3.92	3.28	2.74
Less Depreciation as per IT Act.	**6.85**	5.88	5.07	4.36	3.76	3.26	2.82
Actual profit before tax	**38.13**	**39.77**	**80.01**	**81.67**	**117.19**	**118.64**	**149.04**
Corporate tax (15%)	5.72	5.97	12.00	12.25	17.58	17.80	22.36

DEBT SERVICE COVERGAE RATIO (Rs. in Lakhs)							
HEAD	**YEAR**						
Particulars	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Net profit after tax	30.95	32.82	67.41	69.06	99.45	100.82	126.76
Depreciation	8.31	6.86	5.67	4.72	3.92	3.28	2.74
Interest on term loan	5.42	4.75	3.80	2.85	1.90	0.95	0.00
Interest on working capital loan	4.19	4.19	4.60	4.60	5.06	5.06	5.57
Total : (A)	**48.87**	**48.62**	**81.48**	**81.23**	**110.33**	**110.11**	**135.07**
Interest on term loan	5.42	4.75	3.80	2.85	1.90	0.95	0.00
Interest on working capital loan	4.19	4.19	4.60	4.60	5.06	5.06	5.57
Installment on term loan	7	10	10	10	10	10	0
Total : (B)	**16.61**	**18.94**	**18.40**	**17.45**	**16.96**	**16.01**	**5.57**
DSCR=(A/B)	2.94	2.57	4.43	4.66	6.51	6.88	24.25
Average DSCR	7.46						
Rate of return in the first year=30.95/76.79*100=40.3% and increases continuously in successive yrs.							
Net profit ratio in the first year profit / turn over x 100 =6.3% and increases continuously in successive yrs.							

PROJECTED BREAK EVEN ANALYSIS (Rs. in Lakhs)							
HEAD	**YEAR**						
Particulars	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Capacity utilization	60%	60%	70%	70%	80%	80%	90%
(A) Sales Turnover	501	501	584.5	584.5	668	668	751.5
Variable Overhead							
Cost of manufacture							
Raw materials	**397.93**	**397.93**	**437.72**	**437.72**	**481.49**	**481.49**	**529.64**
Staff and labour (100%)	37.2	37.2	40.92	40.92	45.01	45.01	49.51
Utility (100%)	7.56	7.56	8.32	8.32	9.15	9.15	10.06
Other expenses (100%)	2.64	2.64	2.9	2.9	3.19	3.19	3.51
(B)	445.33	445.33	489.86	489.86	538.84	538.84	592.72
Contribution (A)-(B)=©	55.67	55.67	94.64	94.64	129.16	129.16	158.78
Contribution at 100%cap. (C_1)	92.78	92.78	135.2	135.2	161.45	161.45	176.42
Fixed overhead							
Staff and labour(40%)	14.88	14.88	16.37	16.37	18.00	18.00	19.80
Other expenses (40%)	1.06	1.06	1.16	1.16	1.28	1.28	1.40
Utility (40%)	3.02	3.02	3.33	3.33	3.66	3.66	4.02
Interest on term loan	5.42	4.75	3.8	2.85	1.9	0.95	0
Interest on W.C. loan	4.19	4.19	4.6	4.6	5.06	5.06	5.57
Depreciation	8.31	6.86	5.67	5.67	3.92	3.28	2.74
(D)	36.88	34.76	34.93	33.98	33.82	32.23	33.54
Break Even Point D/C_1 X100	39.75	37.47	25.83	25.13	20.95	19.96	19.01
Average Break Even Point	**26.87**						

Addresses of Machinery and equipment Supplier:

1. Pathak Machine Tools Pvt. Ltd, Plot No. 842, Palasuni, PO Rasulgarh, Bhubaneswar-751010, Mob-098780-19247, 98610-19247, Website- www.pathakmachines.com.

2. M/s Turnwell Machine Tools, 16, G C Avenue, Kolkata, 700013, India, Phone No -: 91-33-2379537, Email Id -: turnwellmachinetools@yahoo.com.

3. Machine Tools, Plot No. 133, Phase-1, New Industrial Estate, Jagatpur, Cuttack-754021, Odisha, Mob- 8895929247, 9124009247, Website: https://www.pathakodisha.com/

4. Chawla&Choudhary Trading Co. Private Limited, A-91/3, Naraina Industrial Area, Phase 1, New Delhi - 110028, Delhi, India, Phone No.- 08048740209, https://www.windingmachine.in.

5. Shree Guru Enterprises, Bhoomi Industrial Estate, WalivPhata Survey, Mumbai-410501- for vacuum impregnation plant.

6. Heatech Systems, Market Road, South Tripunithura, Ernakulum-682301, M-07971480270-for electric furnace

7. Goliya Instruments Private Limited, 311, Bharat Industrial Estate, T.J Road, Sewree, Mumbai 400015, Phone-022-24149657, Website: www.goliyainstruments.com.

8. Toshniwal Industries Pvt. Ltd., Industrial Estate, Makhupura, Ajmer - 305-002, Rajasthan, Phone: +91 844 844 1044, Email: info@tipl.com, Website address:https://www.tipl.com.

9. Rishabh Instruments Pvt. Ltd., F-31, MIDC, Satpur, Nashik - 422007, Maharashtra India, Phone- 91-253 2202202/028 Fax: 91 253 2351064, Email-marketing@rishabh.co.in, website:https://rishabh.co.in/.

10. Yokogawa India Ltd, Plot No. 69, Satya Nagar, Near Kali Mandir, Bhubaneswar - 751007 (Orissa), Phone: (91)-674-2571232.

11. MV International, V-27, Red Cross Road, MIE Part B, Bahadurgarh, Haryana- 124507, https://www.mvinternational.com.

12. www.indiamart.com

Raw Material Supplier:

1. **Cold Rolled Non Grade Electrical Steel Supplier:**

- SAIL, Rourkela Steel Plant, Rourkela, 769011, Ph. 2510018, 2447527
- POSCO Electrical Steel India PvtLtd., Address: 706, World Trade Centre Pune, 1 - Kharadi, Opp. Eon Free Zone, MIDC, Knowledge Park, Pune, Maharashtra 411014 Phone: 02140 662 626
- Thysserkrupp Electrical Steel India Private limited, Address: 3rd Cross, No. 37, 3rd Phase, 4th Main Rd, behind Arvind Motors, Phase 3, Peenya, Bengaluru, Karnataka 560058, Phone: 080 2839 1654
- MI Electrical Steel Processing India Pvt. Ltd., Majrakath, Rajasthan 301020 Phone: 01494 679 000

Cast IronSupplier-

- Jatin Industries | CI Casting | Cast Iron Casting Manufacturer, Address: 87/2B, G I D C , Phase I, Vatva Industrial Estate, Vatva, Ahmedabad, Gujarat 382445, Phone: 079 2583 1425
- Vaarpu - Cast Iron Casting Supplier in India, Address: 60, Vaanagam Rd, Papanaickenpalayam, Venugopal Layout, Coimbatore, Tamil Nadu 641037, Phone: 098652 44430

Aluminium Ingots- AlloyedSupplier:

- NALCO, Nalco Nagar - 759145, Angul, Odisha, PH. 06764 - 220110
- Kamala Metachem, Kolkata, No. 3, British Indian Street, 3rd Floor, Room No. 3D, Beside Great Eastern Hotel, B.B.D. Bagh, Kolkata - 700069, West Bengal, India, Contact-08048718721
- GTR Aluminium PVT. LTD, Plot No. 33 - E, Veerasandra Industrial Area Anekal, Taluk, Bengaluru, Karnataka 560100, Contact- 096111 77616.
- Baheti Metal, A-2/3, L.R. Apartment, opp. Police Comm. office, Shahibag, Ahmedabad, Gujarat 380004, Contact-091792 56276

Winding Wire of Enamelled copper Supplier:

- Khaitan Winding Wire, India Exchange Pl, Chitpur, Barabazar Market, Kolkata, West Bengal 700001, Phone: 033 2225 3846
- Imide Winding Wires(Copper and aluminium winding wire manufacturer),Alipur - Narela Rd, DSIDC Industrial Area, Narela, Delhi, 110040, Phone: 099119 99571.

OthrWst and Scrap of Stainless Steel Supplier-

- Scan Steels LTD., Trishna Nirmalya Bhawan, Plot No. 516/1723/3991, 2nd Floor, Magnetic Chowk, Patia, Bhubaneswar, Odisha 751024, Phone: 0674 272 5564

- SMS group, Plot No. 70, Near Meenaji, Sector-A, Zone-D, Mancheswar Industrial Estate, Bhubaneswar, Odisha 751010, Phone: 0674 258 0720.

2. Details of test facilities available in India

List of Recognized Laboratories:

1. Bharat Test House Pvt Ltd, 781, HSIIC Industrial Estate, Rai Sonepat-131001,Haryana
Contact : Vaibhav Gupta, Director, Tel : 9310314585, Fax : 0130-2367675
Email: bthrai@bharattesthouse.com.

2. Electrical Research & Development Association, P.B. No. 760, ERDA Road, GIDC, Makarpura Industrial Estate, Vadodara-390010, Gujarat, Contact : Hitesh R Karandikar, Director-Mob:09978940911, Tel : 0265-2642942,964,377, Fax : 0265-2648382, Email: erda@erda.org, vinod.gupta@erda.org, mitesh.prajapati@erda.org.

3. Br. MSME Development Institute, 386, Patel Road Ramnagar, Coimbatore-641009, Tamilnadu, Tel : 9443829389, Fax : 0422-2230426.

Email: brdcdi-coim@dcmsme.gov.in
4. NSIC Technical Services Centre, 80 Ft. Road, Near Bhavnagar Road Crossing, Aji Industrial Area, Rajkot-360003, Gujarat, Tel : 0281-2387613,2387396, Fax : 0281-2387729, Email: ntscraj@nsic.co.in.

5. Scientific & Industrial Testing & Research Centre, 83 & 84, Avarampalayam Road, K.R. Puram P.O.Coimbatore-641006, Tamilnadu, Telephone : +91-0422 2560473, 4273612, Mobile: +91-94875 80473, Email sitarcinfo@sitarc.com, Web : www.sitarc.com.

6. TESLA R&D Institute Pvt Ltd, (B1+B2+B3)/24, GIDC Electronics Estate, Sector-25, Gandhinagar-382044, Gujarat, Tel : 7203025333, Email: akj@teslacentre.co.in

7. The National Small Industries Corporation Ltd, Technical Service Centre, Sector B- 24, Guindy Industrial Estate, Ekkaduthangal, Chennai-600032, Tamilnadu, Tel : 044-22251254, Fax : 044-22254500, Email: nsic_energycell@nsic.co.in

8. Electronics and Quality Development Centre, B 177/178, GIDC Electronics Estate, Sector-25, Gandhinagar-382044, Gujarat. Tel : 079-23287119/20/22, Fax : 079-23287121, Email: md@eqdc.in, qm@eqdc.in

9. Pump Testing Laboratory, Guru Nanak Dev Engineering College, Gill Park, Gill Road, Ludhiana-141006, Punjab, Tel : 01615064577,Email: mech@gndec.as.in

10. Rajkot Engineering Testing and Research Centre, Plot No;.372, Aji GIDC, O-road,Rajkot-360003, Gujarat, Tel : 9228253625, Email: cfcrajkot@gmail.com

11. The National Small Industries Corporation Ltd, Technical Service Centre, Sector B- 24, Gindy Industrial Estate, Ekkaduthangal, Chennai-600032, Tamilnadu, Tel : 044-22251254, Fax : 044-22254500, Email: nsic_energycell@nsic.co.in

3. Details of raw material suppliers:

Cold Rolled Non Grade Electrical Steel Supplier:

- SAIL, Rourkela Steel Plant, Rourkela, 769011, Ph. 2510018, 2447527
- POSCO Electrical Steel India PvtLtd.,Address: 706, World Trade Centre Pune, 1 - Kharadi, Opp. Eon Free Zone, MIDC, Knowledge Park, Pune, Maharashtra 411014 Phone: 02140 662 626
- Thysserkrupp Electrical Steel India Private limited, Address: 3rd Cross, No. 37, 3rd Phase, 4th Main Rd, behind Arvind Motors, Phase 3, Peenya, Bengaluru, Karnataka 560058, Phone: 080 2839 1654
- MI Electrical Steel Processing India Pvt. Ltd., Majrakath, Rajasthan 301020 Phone: 01494 679 000

Cast IronSupplier-

- Jatin Industries | CI Casting | Cast Iron Casting Manufacturer,Address: 87/2B, G I D C , Phase I, Vatva Industrial Estate, Vatva, Ahmedabad, Gujarat 382445, Phone: 079 2583 1425
- Vaarpu - Cast Iron Casting Supplier in India, Address: 60, Vaanagam Rd, Papanaickenpalayam, Venugopal Layout, Coimbatore, Tamil Nadu 641037, Phone: 098652 44430

Aluminium Ingots- AlloyedSupplier:

- NALCO, Nalco Nagar - 759145, Angul, Odisha, PH. 06764 - 220110
- Kamala Metachem, Kolkata, No. 3, British Indian Street, 3rd Floor, Room No. 3D, Beside Great Eastern Hotel, B.B.D. Bagh, Kolkata - 700069, West Bengal, India, Contact-08048718721

- GTR Aluminium PVT. LTD, Plot No. 33 - E, Veerasandra Industrial Area Anekal, Taluk, Bengaluru, Karnataka 560100, Contact- 096111 77616.
- Baheti Metal, A-2/3, L.R. Apartment, opp. Police Comm. office, Shahibag, Ahmedabad, Gujarat 380004, Contact-091792 56276

Winding Wire of Enamelled copper Supplier:

- Khaitan Winding Wire, India Exchange Pl, Chitpur, Barabazar Market, Kolkata, West Bengal 700001, Phone: 033 2225 3846
- Imide Winding Wires(Copper and aluminium winding wire manufacturer),Alipur - Narela Rd, DSIDC Industrial Area, Narela, Delhi, 110040, Phone: 099119 99571.

OthrWst and Scrap of Stainless Steel Supplier-

- Scan Steels LTD., TrishnaNirmalyaBhawan, Plot No. 516/1723/3991, 2nd Floor, Magnetic Chowk, Patia, Bhubaneswar, Odisha 751024, Phone: 0674 272 5564

- SMS group, Plot No. 70, Near Meenaji, Sector-A, Zone-D, Mancheswar Industrial Estate, Bhubaneswar, Odisha 751010, Phone: 0674 258 0720.

4. Details of the machinery suppliers:

1. Pathak Machine Tools Pvt. Ltd, Plot No. 842, Palasuni, PO Rasulgarh, Bhubaneswar-751010, Mob-098780-19247, 98610-19247, Website- www.pathakmachines.com.

2. M/s Turnwell Machine Tools, 16, G C Avenue, Kolkata, 700013, India, Phone No -: 91- 33-2379537, Email Id -: turnwellmachinetools@yahoo.com.

3. Machine Tools, Plot No. 133, Phase-1, New Industrial Estate, Jagatpur, Cuttack-754021, Odisha, Mob- 8895929247, 9124009247, Website: https://www.pathakodisha.com/

4. Chawla&Choudhary Trading Co. Private Limited, A-91/3, Naraina Industrial Area, Phase 1, New Delhi - 110028, Delhi, India, Phone No.- 08048740209, https://www.windingmachine.in.

5. Shree Guru Enterprises, Bhoomi Industrial Estate, WalivPhata Survey, Mumbai-410501- for vacuum impregnation plant.

6. Heatech Systems, Market Road, South Tripunithura, Ernakulum-682301, M-07971480270-for electric furnace.

7. Goliya Instruments Private Limited, 311, Bharat Industrial Estate, T.J Road, Sewree, Mumbai 400015, Phone-022-24149657, Website: www.goliyainstruments.com.

8. Toshniwal Industries Pvt. Ltd., Industrial Estate, Makhupura, Ajmer - 305-002, Rajasthan, Phone : +91 844 844 1044, Email : info@tipl.com, Website address:https://www.tipl.com.

9. Rishabh Instruments Pvt. Ltd., F-31, MIDC, Satpur, Nashik - 422007, Maharashtra India, Phone- 91-253 2202202/028 Fax: 91 253 2351064, Email-marketing@rishabh.co.in, website:https://rishabh.co.in/.

10. Yokogawa India Ltd, Plot No. 69, Satya Nagar, Near Kali Mandir, Bhubaneswar - 751007 (Orissa), Phone: (91)-674-2571232.

11. MV International, V-27, Red Cross Road, MIE Part B, Bahadurgarh, Haryana-124507, https://www.mvinternational.com.

12. www.indiamart.com

D. SCHEMES AND CONSULTANCY SERVICES

1. Existing schemes available and their details

(I) Projects for Squirrel Cage Induction motors may be accorded priority in consideration under CGTMSE scheme of our Ministry.

(II) Under CLCS Scheme, an existing unit can be supported for purchasing new machineries uptoRs. 100 lakh with 15% subsidy from M/o MSME for upgradation of technology for producing Squirrel Cage Induction motors.

(III) Units may be encouraged to set up in this sector and such groups of units may be facilitated under MSE-CDP.

EESL's National Motor Replacement Program (NMRP)

Riding high on the success of "Demand Aggregation" model in energy efficient products, Energy Efficiency Services Limited (EESL is a joint venture of PSUs under Ministry of Power,Govt. of India) aims to create an infrastructure to fuel supply for High Efficient Motors adhering to IE-3 standard through upfront investment, awareness creation, capacity building of manufacturers and developing success cases to convince decision makers.

The National Motors Replacement Programme (NMRP) shall offer appropriate technical specifications (as per IS-12615) keeping in mind key customer pain points viz. high initial costs, high operating and maintenance costs and quality of the products.

EESL is targeting the 3-phase LT induction motors in the capacity range of 0.75 kW to 75 kW preferably directly-coupled with loads like pumps, fans, blowers, air compressors etc.

Key Technical Specification

Parameters Specifications (As per IS 12615)

Type **3-Phase, LV Induction Motor**

Pole 2,4,6

Mounting Foot & Flange

Voltage (V) 415 V (±10%)

Frequency (Hz) 50 Hz (±5%)

Efficiency Class IE-3

Ratings (KW) 0.75, 1.1, 1.5, 2.2, 3.7, 5.5, 7.5, 11, 15, 18.5, 22, 30, 37, 45, 55, 75

- **Financial Model:**

EESL Model # 1: PMC Model / Supply Contract

In the Project Management Consultancy (PMC) model, the user shall bear the product cost whereas EESL provides the PMC support to the users. The PMC support includes the following:

Finalization of the scheme for replacement: Number of motors to be replaced, technical specifications, estimation of energy saving, investment requirement etc.

Procurement of Motors: Through open competitive bidding

Supply of Motors at User Site: Facilitation/Management of supply of motors at the user site with due coordination with the supplier

Warranty Obligation: Ensuring the warranty obligation with the supplier

Update in National Motor Dashboard: Estimated Energy Saving and other benefits to be reflected in a national dashboard

Payment Terms: The user shall be liable to pay the entire project cost post-delivery of motors within mutually agreed time frame (typically within 30 days)

EESL Model # 2: ESCO Model / Shared Saving Model

In this model, the entire upfront investment will be done by EESL in addition to the PMC activities as described above. Here, the project cost will therefore be material cost-plus PMC fees plus the finance cost for timeline mutually agreed by user and EESL. Here, repayment to EESL by the user will be done through Equated Quarterly Installments (EQIs) for three year period. For this modality client has to submit the payment security (BG/LC) to EESL.

It is observed that the repayment amount to EESL by the end-user is about 50-70% of the monetized savings accruing through the improvement in efficiency of the motor.

Benefits:

Due to the higher domestic demand, the Indian motor industry's design and manufacturing capabilities will advance towards the global best practice level of IE3 at an accelerated pace, and provide economies of scale for higher exports. The replacement program will create additional skilled employment in technical services, financial services, manufacturing, sales, installation, after sales services, recycling etc. The final beneficiaries (at the level of the overall objectives) are shown below

- **Customer:**
- Energy Savings & Cost savings
- Access to superior 'green' product
- Financial advantage through EESL's business model
- **Motor Manufacturer:**
- Better capacity utilization through increased demand for IE3 motors
- Enhanced market reach
- Market expansion for the motor replacement market
- **Government and Utilities:**
- Reduced demand for electricity and better peak load management
- **Nation**
- Reduced power shortages
- Energy Security
- Contribution to India's climate change goals by reducing GHG emissions

Source: https://eeslindia.org/en/nmrp/

2. Proposed Scheme (if existing not suitable):

Under the Production-Linked Incentive Scheme of Atma Nirbhar Bharat, an incentive of 4% to 6% on incremental sales (over base year) of goods manufactured in India and covered under target segments, to eligible companies, for a period of five (5) years subsequent to the base year as defined is provided.

The scheme benefits may be extended to manufacturing of electrical motors in general, and squirrel cage induction motors specifically, to give a fillip to their domestic manufacturing while bringing down their cost and reducing imports.

A similar Scheme like **Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS) which** aims to strengthen the manufacturing ecosystem for electronic components and semiconductors may be proposed for promoting manufacturing of Squirrel Cage Induction motors. Under SPECS, Incentive of 25% on Capital Expenditure pertaining to plant, machinery, equipment, associated utilities and technology, including Research & Development on reimbursement basis is provided to New Units as well as Expansion of Existing Units.

(Ref:https://static.investindia.gov.in/2020-04/SPECS%20Gazette%20Notification%20-%2001.04.20.pdf)

3. Details of agencies who can provide guidance:

I. MSME-DIs, TCs across India (http://dcmsme.gov.in/All_MSME_DIs_TCs.aspx)

II. Energy Efficiency Services Limited, NFL Building, 5th & 6th Floor, Core – III, SCOPE Complex, Lodhi Road, New Delhi – 110003, Phone : 011- 45801260, Email: helpline@eesl.co.in

III. Electrical Research & Development Association, P.B. No. 760, ERDA Road, GIDC, Makarpura Industrial Estate, Vadodara-390010, Gujarat. Tel : 0265-

2642942,964,377,Fax:0265-2648382,Email: erda@erda.org,vinod.gupta@erda.org,mitesh.prajapati@erda.org

IV. Scientific & Industrial Testing & Research Centre, 83 & 84, Avarampalayam Road, K.R. Puram P.O.Coimbatore-641006, Tamilnadu, Tel : 0422-2562612,2560473, Fax : 0422-2562612, Email: sitarcinfo@sitarc.com

V. NSIC Technical Services Centre, Sector B- 24, Guindy Industrial Estate, Ekkaduthangal, Chennai-600032, Tamilnadu, Tel : 044-22251254, Fax : 044-22254500, Email: nsic_energycell@nsic.co.in

VI. Electronics and Quality Development Centre, B 177/178, GIDC Electronics Estate, Sector-25, Gandhinagar-382044, Gujarat. Tel : 079-23287119/20/22, Fax : 079-23287121, Email: md@eqdc.in, qm@eqdc.in.

VII. Bureau of Indian Standard, 6TH Floor, Gruha Nirman Bhavan, (OSHB Building), Sachivalaya Marg, Bhubaneswar-751001, Tel- 0674-2394193, Email- bhbo@bis.gov.in, Website: www.bis.gov.in.

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