DETAILED PROJECT REPORT
ON
ENERGY EFFICIENT MOTOR IN ROTARY FURNACE
(10 HP)
(BATALA, JALANDHAR, LUDHIANA FOUNDRY CLUSTER)

ENERGY IS LIFE
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Bureau of Energy Efficiency (BEE)

Prepared By

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ENERGY EFFICIENT MOTOR IN ROTARY FURNACE (10 HP)

BATALA, JALANDHAR, LUDHIANA FOUNDRY CLUSTER

BEE, 2011

Detailed Project Report on Energy Efficient Motor in Rotary Furnace (10 HP)

Foundry SME Cluster, Batala, Jalandhar , Ludhiana (Punjab) (India)

New Delhi: Bureau of Energy Efficiency

Detail Project Report No.: **BJL/CAP/PF/01**

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CII – AVANTHA Centre for Competitiveness for SMEs, Confederation of Indian Industry (CII) is also thankful to Industry Associations for their valuable inputs, cooperation, support and facilitating the implementation of BEE SME program in BJL Foundry Cluster.

We take this opportunity to express our appreciation for the excellent support provided by Foundry Unit Owners, Local Service Providers, and Equipment Suppliers for their active involvement and their valuable inputs in making the program successful and in completion of the Detailed Project Report (DPR).

CII – AVANTHA Centre for Competitiveness for SMEs, Confederation of Indian Industry (CII) is also thankful to all the SME owners, plant in charges and all workers of the SME units for their support during the energy use and technology audit studies and in implementation of the project objectives.

CII – AVANTHA Centre for Competitiveness for SMEs

Confederation of Indian Industry

Chandigarh

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List of Abbreviations

BEE	Bureau of Energy Efficiency
SME	Small and Medium Enterprises
DPR	Detailed Project Report
GHG	Green House Gases
EEF	Energy Efficient Motor
CDM	Clean Development Mechanism
DSCR	Debt Service Coverage Ratio
IRR	Internal Rate of Return
ROI	Return on Investment
MT	Metric Tonne
SIDBI	Small Industries Development Bank of India

EXECUTIVE SUMMARY

Confederation of Indian Industry is executing BEE-SME program in Batala, Jalandhar and Ludhiana Foundry Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Batala, Jalandhar and Ludhiana Foundry cluster, is one of the largest Foundry clusters in India; accordingly this cluster was chosen for energy efficiency improvements by implementing energy efficient measures / technologies, so as to facilitate maximum replication in other Foundry clusters in India. The main energy forms used in the cluster units are grid electricity.

Most of the Industrial installations in the country have large electrical loads which are severely inductive in nature, such as motors, large machines etc which results in a high power consumption. This means loss and wastage of energy by electricity boards as well as for Foundry units. This can be taken care by Energy Efficient Motors in place of Old / Re-winded Motors.

Implementation of Energy efficient motors will reduce the running cost of energy. It helps in reducing the electricity bill amount by availing the benefit of improvement in efficiency of motor and so reduction in power consumption from the Punjab State Electricity Board.

Project implementation will lead to reduction in electricity bill by ` 0.19 Lakh per year. This DPR highlights the details of the study conducted for the Energy Efficient Motor in melting Furnace, possible Energy saving and its monetary benefit, availability of the technologies/design, local service providers, technical features & proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, sensitivity analysis in different scenarios and schedule of Project Implementation.

This bankable DPR also found eligible for subsidy scheme of MoMSME for “Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises” under “National Manufacturing and Competitiveness Programme”. The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table.

S. No.	Particular	Unit	Value
1	Project cost	` (in lakh)	0.52
2	Monetary benefit	` (in lakh)	0.19
3	Debit equity ratio	Ratio	3:1

S. No.	Particular	Unit	Value
4	Simple payback period	years	2.74
5	NPV	` (in lakh)	0.21
6	IRR	%age	21.49
7	ROI	%age	25.13
8	Process down time	hours	6 to 8
9	DSCR	Ratio	1.57
10	Co_2 reduction	Ton/year	3.1

The projected profitability and cash flow statements indicate that the project implementation will be financially viable and technically feasible.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve energy performance in 29 selected SMEs clusters. Batala, Jalandhar and Ludhiana Foundry Cluster is one of them. The BEE's SME Programme intends to enhance energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up gradation through studies and pilot projects in these SMEs clusters.

Major Activities in the BEE - SME Program are furnished below:

Activity 1: Energy Use and Technology Audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Activity 2: Capacity Building of Stake Holders in Cluster on Energy Efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting of energy efficiency projects in the clusters.

Activity 3: Implementation of Energy Efficiency Measures

To implement the technology up gradation projects in clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Activity 4: Facilitation of Innovative Financing Mechanisms for Implementation of Energy Efficiency Projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion.

1. INTRODUCTION

1.1. Brief Introduction about the Cluster

Indian foundry industry is very energy intensive. The energy input to the furnaces and the cost of energy play an important role in determining the cost of production of castings. Major energy consumption in medium and large scale foundry industry is the electrical energy for induction and Arc furnaces. Furnace oil is used in rotary furnaces. In Small foundry industry, coal is used for metal melting in Cupola furnaces. The energy costs contribute about 25 - 30% of the manufacturing cost in Indian foundry industry.

There are approximately 450 units, engaged in Foundry Cluster (automobile parts, agricultural implements, machine tools, diesel engine components, manhole covers, sewing machine stands, pump-sets, decorative gates and valves) production. The major locations wherein the units are spread are G.T. Road, Industrial area, Focal Point in Batala. In Jalandhar Dada Colony Industrial Area, Focal point, Focal Point Extn, Udyog Nagar, I.D.C, Kapurthala Road & Preet Nagar. In Ludhiana Focal Point Phase 5 to 8, Janta Nagar, Bhagwan Chowk Area & Industrial area – A/B. .

Availability of Electricity in Batala – across Dhir Road, GT Road is an issue; power is available from the grid for maximum 12/14 hours a day. There are some units in Jalandhar and Ludhiana having induction furnace in the range of 500 kg to 1 ton capacity whereas other units which are using local scrap as well as have high melting temperatures are having cupola and rotary furnace and has a capacity of minimum 5 ton per day.

The foundry produces a wide variety of castings such as manhole covers, pipe and pipe fittings, sanitary items, tube well body, metric weights, automobile components, railway parts, electric motor, fan body etc. 90% of the castings produced are from the SSI sector.

Energy Usage Pattern

Major energy sources being used in foundry cluster are electricity and fuels such as Coal, Furnace Oil, and Diesel. Electrical energy is being used in melting of iron in induction furnaces, operation of electrical utilities and thermal energy is being used in cupola furnaces operation.

Classification of Units

Broadly units are classified with respect to production capacity;

- Large Scale Units

- Medium Scale Units
- Small Scale Units

1.2. Production Wise Unit Breakup

Foundry cluster at Batala, Jalandhar and Ludhiana can be broken into three categories viz. small, medium and large size unit. Table 1.2 shows that production wise breakup of Foundry cluster.

Table 1.1 Production wise unit breakups

S. No.	Type of Unit	Production Capacity
1	Large scale unit	More than 1500 MT
2	Medium scale unit	250 to 1500 MT
3	Small scale unit	Less than 250 MT

Products Manufactured

Foundry SME cluster at Batala, Jalandhar and Ludhiana produces a wide variety of castings such as manhole covers, pipe and pipe fittings, sanitary items, tube well body, metric weights, automobile components, railway parts, electric motor, fan body etc.

Process Flow diagram of a Foundry Cluster:

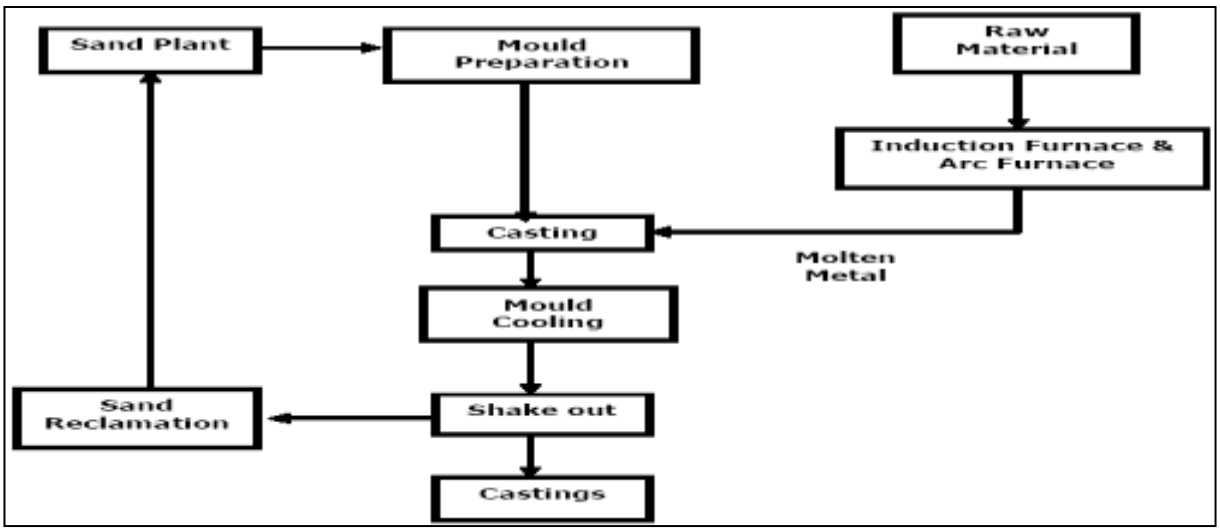

Figure 1.1 Process flow diagram of Oil Mill Units

The manufacturing process is described as below;

Melting Section:

The raw material is melted in melting furnace. The melting furnace can be an induction furnace or rotary or arc furnace or cupola furnace. Molten metal from the melting furnace is tapped in Ladles and then transferred to the holding furnaces. Typically the holding furnaces are induction furnaces. The holding furnace is used to maintain the required molten metal temperature and also acts as a buffer for storing molten metal for casting process. The molten metal is tapped from the holding furnace whenever it is required for casting process.

Sand Plant:

Green sand preparation is done in the sand plant. Return sand from the molding section is also utilized again after the reclamation process. Sand Millers are used for green sand preparation. In the sand millers, green sand, additives and water are mixed in appropriate proportion. Then the prepared sand is stored in bunkers for making moulds.

Pattern Making:

Patterns are the exact facsimile of the final product produces. Generally these master patterns are made of aluminum or wood. Using the patterns the sand moulds are prepared.

Mould Preparation:

In small-scale industries still the moulds are handmade. Modern plants are utilizing pneumatic or hydraulically operated automatic molding machines for preparing the moulds. After the molding process if required the cores are placed at the appropriate position in the moulds. Then the moulds are kept ready for pouring the molten metal.

Casting:

The molten metal tapped from the holding furnace is poured into the moulds. The molten metal is allowed to cool in the moulds for the required period of time and the castings are produced. The moulds are then broken in the shake out for removing the sand and the used sand is sent back to the sand plant for reclamation and reuse. The castings produced are sent to fettling section for further operations such as shot blasting, heat treatment etc. depending upon the customer requirements.

1.3. Energy performance in existing situation

Major energy sources being used in foundry cluster are electricity and fuels such as Coal, Furnace Oil, and Diesel. Electrical energy is being used in melting of iron in

induction furnaces, operation of electrical utilities and thermal energy is being used in cupola furnaces operation.

1.3.1. Average Production

The Average Production of the Foundry Units in above mentioned category during Year 2009-10 are as follows;

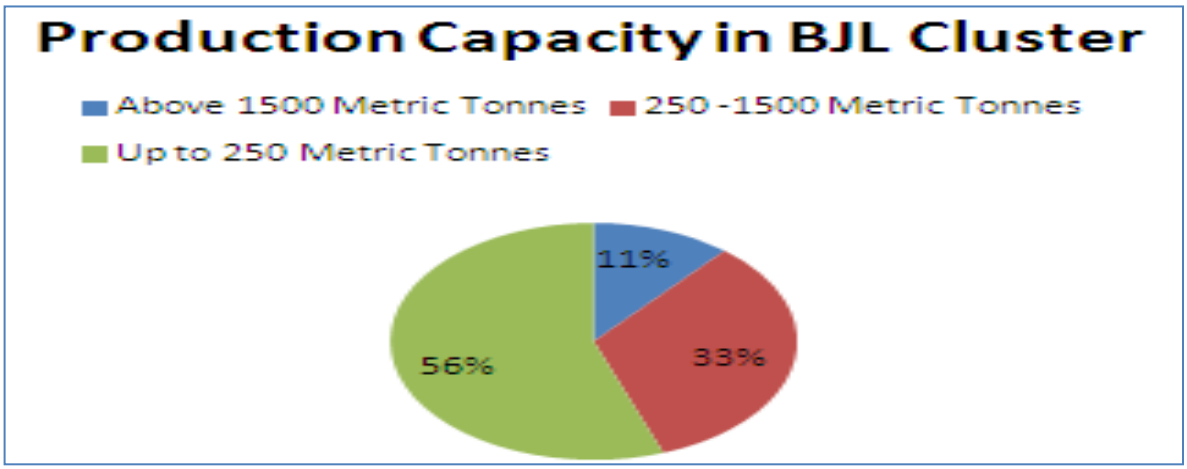

Figure 1.2 Production Capacity in BJL Cluster

1.3.2. Energy Consumption

Energy consumption (electrical) in a typical Foundry plant for different types of products is given in Table 1.2 below:

Table 1.2 Annual Energy Consumption

Electricity Consumption Pattern	Unit Consumed in kWh	Total Unit Consumption kWh
Blower Motor for Cupola	962100	26.92 Lakhs
Rotary Motor for Rotary Furnace	330000	
Melting material in Induction Furnace	1400000	

Table 1.3 Annual Thermal Energy Consumption

Thermal Energy Consumption Pattern	Consumption per Year
Coal for Cupola	5000 Metric Tonnes
Furnace Oil for Rotary Furnace	17.8 Lakhs Litter

1.3.3. Specific Energy Consumption

Specific energy consumption of Foundry units depends upon the production capacity & their corresponding power consumption. Specific energy consumption also depends on type of furnace. A brief summary of specific energy consumption depending upon type of furnace is shown in below table;

Table 1.4 Specific Fuel consumption

S. No	Types of Furnace	Types of Fuel	Specific Fuel Consumption per kg Molten Material	In `*
1	Cupola	Coal	0.2 kg	3.0
2	Rotary Furnace	Furnace Oil	0.15 Lt	4.20
3	Induction Furnace	Electricity	0.72 kWh	3.6

* Coal rate at `15.0 /kg

* F.O rate at ` 28.0 /Lt.

*Electricity rate at ` 5.0/kWh

1.4. Proposed Technology/Equipment

1.4.1. Description about the existing technology

During the audit it was observed that the maximum of motors are re-winded more than 5 times which leads to approx 2.5 times more power consumption and lower operating efficiency. These motors must be replaced by the Energy Efficient Motors which leads to higher working efficiency up to 4 % for the same working condition. Rotary motor in a melting furnace is the main electrical energy consumer in any Foundry unit. Induction motor of around 10 HP is used in the rotary furnace. The rated voltage of the motor is 415 V, frequency is 50 Hz, insulation class is F, 1500 RPM, 4 pole, Flame proof and rated output is 7.5kW.The IS for the motor is IS 325. It was observed that the maximum of motors are re-winded more than 5 times which leads to higher power consumption and lower operating efficiency. Also old en-efficient motors in the efficiency range of 70 - 80% are in use. The Foundry units in the cluster varies their operating hours and days as per their requirement and the considered unit operates for 300 days a year and 15 hours per day of operation meanwhile operating on full load at major part of operating hours.

Table 1.5 Technical Specifications of Existing Motor

S. No.	Parameters	Value
1.	Rated Capacity (HP / kW)	10 /7.5
2.	Rated Voltage (V)	415
3.	Frequency (Hz)	50
4.	Induction Class	F
5.	RPM (rpm)	1500
6.	Pole	4
7.	Efficiency (%)	80
8.	Operating Hours (hrs)	4500
9.	Standard	IS 325

1.5. Establishing the Baseline for the Proposed Technology

Presently all the Foundry units in Batala, Jalandhar and Ludhiana are operating with very old and inefficient motors. Installation of Energy efficient motors in place of re-winded motors will save the power as Energy efficient motors (EEF1) have 4-5 % efficiency higher than standard motor. Rotary motor in a rotary furnace is the main electrical energy consumer in any Foundry unit. Induction motor of around 10 HP is used for as rotary of the melting furnaces. The rated voltage of the motor is 415 V, frequency is 50 Hz, insulation class is F, 1500 RPM, 4 pole, Flame proof and rated output is 7.5kW. The IS for the motor is IS 325. It was observed that the maximum of motors are re-winded more than 5 times which leads to higher power consumption and lower operating efficiency. Also old en-efficient motors in the efficiency range of 70 - 80% are in use.

Table 1.6 Baseline Establishment

S. No.	Parameter	Unit	Value
1.	Rated Power	HP	10
2.	Operational Efficiency	%	80
3.	Operating Hours	Hr. / Day	15
4.	Operating Days	Days / Year	300
5.	Measured Power	kWh/ Hour	7.50
6.	Estimated Consumption	kWh/ Year	33750
7.	Cost of Electricity	` / kWh	5
8.	Total Energy Cost	` / Year	168750

1.6. Barriers in adoption of proposed technology

1.6.1. Technological Barrier

- Lack of awareness and information of the loss in terms of efficiency for re-winded and energy efficient motors
- Due to lack of technical knowledge and expertise, re-winded motors are used in the Foundry units.
- In this cluster, like many others, there is lack of leadership to take up the energy efficiency projects in the plant.

1.6.2. Financial Barrier

Availing finance is not the major issue. Among the SMEs, the larger units, if convinced they are capable of either financing it themselves or get the finance from their banks. The smaller units will require competitive loan and other support to raise the loan.

However as most of them have been able to expand their setup and grow, there is readiness to spend for energy efficiency technologies which have good returns. Energy Efficiency Financing Schemes such as SIDBI's, if focused on the cluster, will play a catalytic role in implementation of identified energy conservation projects & technologies.

1.6.3. Skilled Manpower

In Foundry cluster at Batala, Jalandhar and Ludhiana, the availability of skilled manpower is one of the limitations; this issue gets further aggravated due to more number of Foundry units as compared to the availability of skilled manpower. For major equipments of Foundry units like Cupola furnace, Rotary furnaces for maintenance or the repair works of these equipments take care by the equipment suppliers itself.

2. PROPOSED TECHNOLOGY

2.1. Detailed Description of Technology

2.1.1. Description of Technology

During the audit it was observed that the maximum of motors are re-winded more than 5 times which leads to approx 2.5 times more power consumption and lower operating efficiency. These motors must be replaced by the Energy Efficient Motors which leads to higher working efficiency up to 4 % for the same working condition. Energy-efficient motors (EEM) are the ones in which, design improvements are incorporated specifically to increase operating efficiency over motors of standard design. Design improvements focus on reducing intrinsic motor losses. Improvements include the use of lower-loss silicon steel, a longer core (to increase active material), thicker wires (to reduce resistance), thinner laminations, smaller air gap between stator and rotor, copper instead of aluminum bars in the rotor, superior bearings and a smaller fan, etc. Energy-efficient motors now available in India operate with efficiencies that are typically 3 to 4 percentage points higher than standard motors. In keeping with the stipulations of the BIS, energy-efficient motors are designed to operate without loss in efficiency at loads between 75 % and 100 % of rated capacity. This may result in major benefits in varying load applications. The power factor is about the same or may be higher than for standard motors.

Figure 2.1 Energy Efficient Motor

Power Saving = power consumption $[(1/eff)_{old} – (1/eff)_{new}]$

Standard vs High Efficiency Motors

Efficient motors have lower operating temperatures and noise levels, greater ability to accelerate higher-inertia loads, and are less affected by supply voltage fluctuations.

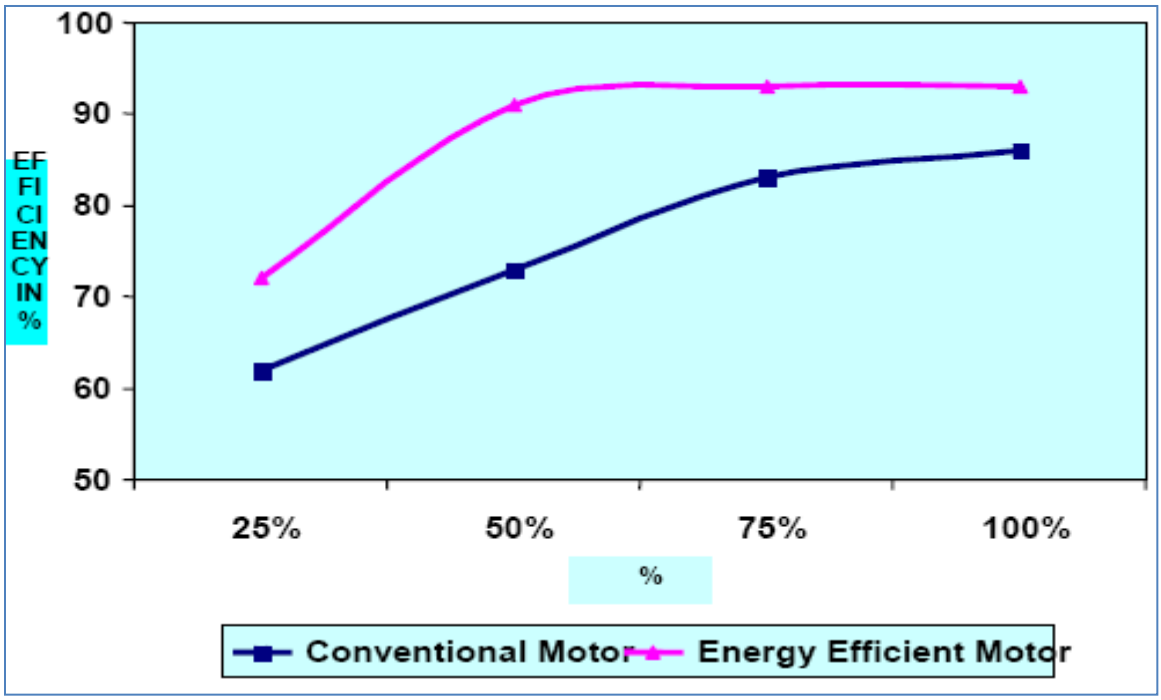

Figure 2.2 Efficiency comparison between Conventional Motor and Energy Efficient Motor

Energy Efficient Motors

Energy-efficient motors (EEM) are the ones in which, design improvements are incorporated specifically to increase operating efficiency over motors of standard design. Design improvements focus on reducing intrinsic motor losses. Improvements include the use of lower-loss silicon steel, a longer core (to increase active material), thicker wires (to reduce resistance), thinner laminations, smaller air gap between stator and rotor, copper instead of aluminum bars in the rotor, superior bearings and a smaller fan, etc. Energy-efficient motors now available in India operate with efficiencies that are typically 4 to 5 percentage points higher than standard motors. In keeping with the stipulations of the BIS, energy-efficient motors are designed to operate without loss in efficiency at loads between 75 % and 100 % of rated capacity. This may result in major benefits in varying load applications. The power factor is about the same or may be higher than for standard motors. Furthermore, energy-efficient motors have lower operating temperatures and noise levels, greater ability to accelerate higher-inertia loads, and are less affected by supply voltage fluctuations.

Advantages

- Less power consumption
- High efficiency

- Less losses
- Wide range with good efficiency
- Less starting torque

2.1.2. Technology Specification

For implementation of the proposed project, energy deficient motors must be replaced with energy efficient motors in the Foundry units. The proposed foot mounted energy efficient motor of rated capacity 7.5 kW /10 HP, the rated voltage for the motors is 415 V, Frequency is 50 Hz, Insulation class F, 1500 RPM, 4 Pole, Flame Proof, rated output is 7.5 kW and have 90 % efficiency. The IS code for energy efficient motors is 12615.

Table 2.1 Technical Specifications of Proposed Motor

S. No.	Parameters	Value
1.	Rated Capacity (HP / kW)	10 /7.5
2.	Rated Voltage (V)	415
3.	Frequency (Hz)	50
4.	Induction Class	F
5.	RPM (rpm)	1500
6.	Pole	4
7.	Efficiency (%)	90.1
8.	Operating Hours (hrs)	4500
9.	Standard	IS 325
10.	Protection Level	IP55

2.1.3. Suitability or Integration with Existing Process and Reasons for Selection

This is the simplest and widely accepted measure for energy cost reduction in all the industries. It does not affect the process but improves the process efficiency and these types of motors with high operating efficiency gives results for a good period of time.

2.1.4. Availability of Technology

Now days when energy cost is high, it is poor practice to use re-winded motors. As far as technology is concerned energy efficient motors are available in local/ national market. It is well proven technology which is adopted in many of the other similar and dissimilar units. Local vendors can arrange energy efficient motors at order. Local service providers are also available at Batala, Jalandhar and Ludhiana. More details of service provider are given in annexure 6.

2.1.5. Source of Technology

The main source which has taken the initiative to create the awareness for implementation of this project by providing the benefit to the consumers in terms of rupees is the State Electricity Board. With use of energy efficient motors, State Electricity Distribution Board will be able to deliver more power to other industry.

2.1.6. Terms and Conditions after Sale

Warranty period of one year will be provided from the date of invoice against any manufacturing defects.

2.1.7. Process down Time during Implementation

Technology provider will bring the complete setup for the proposed project from their site and make all the arrangements for implementation at the client's site. To install EE motor the process down time would be around 6 to 8 hours.

2.2. Life Cycle Assessment

Life of the proposed energy efficient motors will be around 10 to 15 years which depends on the operating conditions and maintenance at client's side.

2.3. Suitable Unit for Implementation of the Identified Technology

For estimation of the saving potential on implementation of this project, here the Foundry units engaged in making castings, having old and re-winded motors can be considered.

3. ECONOMIC BENEFITS FROM PROPOSED TECHNOLOGY

3.1. Technical Benefits

3.1.1. Electricity savings per year

Project of Installation of Energy Efficient Motors in place of Old and re-winded motors will result in savings of electricity consumption in Foundry units which is estimated about 3783 kWh per year due to its high operating efficiency.

3.1.2. Improvement in product quality

This project is not contributing to any improvement in product quality, but frequent burning of motors can be reduced.

3.1.3. Improvement in production

This project is not contributing for increasing in production in Foundry units. But it reduces the power consumption for producing the same casting.

3.1.4. Reduction in raw material consumption

Raw material consumption will be the same after the implementation of the proposed project.

3.1.5. Reduction in other losses

This project does not contribute to any reduction in any loss.

3.2. Monetary Benefits

Annual monetary savings with installation of Energy Efficient Motors will be ` 0.19 Lakh per year/motor.

Table 3.1 Monetary Savings Estimation

S. No.	Parameters	Units	Existing Motor	Proposed EE Motor
1.	Rated Power	HP	10	10
2.	Rated Power	kW	7.5	7.5
3.	Operational Efficiency	%	80	90.1
4.	Operating Hours	Hr. / Day	15	15
5.	Operating Days	Days / Year	300	300
6.	Measured Power	kWh/ Hour	7.50	6.66
7.	Estimated Consumption	kWh/ Year	33750.0	29966.7
8.	Cost of Electricity	` / kWh	5	5
9.	Total Energy Cost	` / Year	168750	149834
10.	Energy Savings	kWh/ Year		3783.3

S. No.	Parameters	Units	Existing Motor	Proposed EE Motor
11.	Monetary Benefits	` / Year		18916.5
12.	Payback Period	Years		2.74

3.3. Social Benefits

3.3.1. Improvement in Working Environment in the Plant

There is no significant impact of this project in the working environment in the plant.

3.3.2. Improvement in Skill Set of Workers

The technical skills of workers will definitely improve. Training on the regular maintenance will help in improving the technical understanding of the workers.

3.4. Environmental Benefits

The major GHG reduction would be in CO_2 reduction. The technology will reduce grid electricity consumption and emission reductions are estimated to be 3.10 tonnes of CO_2 annum.

4. INSTALLATION OF THE PROPOSED TECHNOLOGY

4.1. Cost of Technology Implementation

4.1.1. Technology Cost

The Cost of the technology Energy Efficient Motor as provided by the vendor is ` 44766 with discount of 55% and Excise duty & VAT as applicable charged extra.

Table 4.1 Details of Proposed Technology Installation Cost

S. No.	Particular	Cost (` in Lakhs)
1	Machinery Cost (With 55% discount)	44766
2	Excise Duty	4867
3	Taxes	2238.3
4	Total	51871.3

4.1.2. Other Cost

Other costs required will include Taxes and Excise duty amounts ` 7105.3.

4.2. Arrangements of Funds

4.2.1. Entrepreneur's Contribution

Entrepreneur will contribute 25% of the total project cost which is ` 0.13 Lakh.

4.2.2. Loan Amount

Remaining 75% cost of the proposed project will be borrowed from bank, which is ` 0.39 Lakh.

4.2.3. Terms & Conditions of Loan

The interest rate is considered at 10% which is normal rate of interest for energy efficiency projects. The loan tenure is 5 years excluding initial moratorium period is 6 months from the date of first disbursement of loan.

4.3. Financial Indicators

4.3.1. Cash Flow Analysis

Profitability and cash flow statements have been worked out for a period of 8 years. The financials have been worked out on the basis of certain reasonable assumptions, which are outlined below.

- The Operation and Maintenance cost is estimated at 2 % of cost of total project with 2 % increase in every year as escalations.

- Interest on term loan is estimated at 10 %.
- Depreciation is provided as per the rates provided in the companies Act.

Based on the above assumptions, profitability and cash flow statements have been prepared and calculated in Annexure-3.

4.3.2. Simple Payback Period

The total project cost of the proposed technology is ` 0.52 Lakh and monetary savings due to reduction in electricity consumption is ` 0.19 Lakh hence, the simple payback period works out to be 2.74 years.

4.3.3. Net Present Value (NPV)

The Net present value of the investment at 10% works out to be ` 0.21 Lakh.

4.3.4. Internal Rate of Return (IRR)

The after tax Internal Rate of Return of the project works out to be 21.49%. Thus the project is financially viable.

4.3.5. Return on Investment (ROI)

The average return on investment of the project activity works out at 25.13%.

Table 4.2 Financial Indicators of Proposed Technology

S No	Particular	Unit	Value
1	Simple Payback	Year	2.74
2	NPV	` In Lakh	0.21
3	IRR	%age	21.49
4	ROI	%age	25.13
5.	DSCR	Ratio	1.57

4.4. Sensitivity analysis in realistic, pessimistic and optimistic scenarios

A sensitivity analysis has been carried out to ascertain how the project financials would behave in different situations like when there is an increase in rupees savings or decrease in rupees savings. For the purpose of sensitive analysis, two following scenarios have been considered.

- Optimistic scenario (***Increase in monetary savings by 5%***)
- Pessimistic scenario (***Decrease in monetary savings by 5%***)

In each scenario, other inputs are assumed as a constant. The financial indicators in each of the above situation are indicated along with standard indicators.

Table 4.3 Sensitivity Analysis in Different Scenarios

Scenario	Monetary Benefit(` in Lakh/year)	IRR (%)	NPV(in Lakh)	ROI (%)	DSCR
Pessimistic	0.18	19.60	0.17	24.81	1.50
Base	0.19	21.49	0.21	25.13	1.57
Optimistic	0.20	23.35	0.25	25.41	1.65

4.5. Procurement and Implementation Schedule

Procurement and implementation schedule required for implementation of this technology is about 7 weeks and 6 to 8 hours required as a process break down. Details of procurement and implementation schedules are shown in Table 4.4 below

Table 4.4 Procurement and Implementation Schedule

S. No.	Activities	Weeks						
		1	2	3	4	5	6	7
1	Identification of Old and inefficient motors							
2	Planning and material order							
3	Procurement							
4	Commissioning							

ANNEXURES

Annexure 1: Energy audit data used for baseline establishment

S. No.	Parameter	Unit	Value
1.	Rated Power	HP	10
2.	Operational Efficiency	%	80
3.	Operating Hours	Hr. / Day	15
4.	Operating Days	Days / Year	300
5.	Measured Power	kWh/ Hour	7.50
6.	Estimated Consumption	kWh/ Year	33750
7.	Cost of Electricity	` / kWh	5
8.	Total Energy Cost	` / Year	168750

Presently all the Foundry units in Batala, Jalandhar and Ludhiana are operating with very old and inefficient motors. Installation of Energy efficient motors in place of re-winded motors will save the power as Energy efficient motors (EEF1) have 4-5 % efficiency higher than standard motor. Rotary furnace motor is the main electrical energy consumer in any Foundry unit. Induction motor of around 10 HP is used for the Rotary motor of the melting furnaces like rotary furnace. The rated voltage of the motor is 415 V, frequency is 50 Hz, insulation class is F, 1500 RPM, 4 pole, Flame proof and rated output is 7.5kW. The IS for the motor is IS 325. It was observed that the maximum of motors are re-winded more than 5 times which leads to higher power consumption and lower operating efficiency. Also old in-efficient motors in the efficiency range of 70 - 80% are in use.

Annexure 2: Detailed Technology Assessment Report

For implementation of the proposed project, energy deficient motors must be replaced with energy efficient motors in the Foundry units. The proposed foot mounted energy efficient motor of rated capacity 7.5 kW /10 HP, the rated voltage for the motors is 415 V, Frequency is 50 Hz, Insulation class F, 1500 RPM, 4 Pole, Flame Proof, rated output is 7.5 kW and have 90 % efficiency. The IS code for energy efficient motors is IS 325

S. No.	Parameters	Value
1.	Rated Capacity (HP / kW)	10 /7.5
2.	Rated Voltage (V)	415
3.	Frequency (Hz)	50
4.	Induction Class	F
5.	RPM (rpm)	1500
6.	Pole	4
7.	Efficiency (%)	90.1
8.	Operating Hours (hrs)	4500
9.	Standard	IS 325
10.	Protection Level	IP55

Technology Assessment Report

S. No.	Parameters	Units	Existing Motor	Proposed EE Motor
1.	Rated Power	HP	10	10
2.	Rated Power	kW	7.5	7.5
3.	Operational Efficiency	%	80	90.1
4.	Operating Hours	Hr. / Day	15	15
5.	Operating Days	Days / Year	300	300
6.	Measured Power	kWh/ Hour	7.50	6.66
7.	Estimated Consumption	kWh/ Year	33750.0	29966.7
8.	Cost of Electricity	` / kWh	5	5
9.	Total Energy Cost	` / Year	168750	149834
10.	Energy Savings	kWh/ Year		3783.3
11.	Monetary Benefits	` / Year		18916.5
12.	Payback Period	Years		2.85

Annexure 3: Detailed Financial Calculations

Name of the Technology	Rotary Furnace Motor		
Rated Capacity	**10 HP / 7.5 kW**		
Details	**Unit**	**Value**	**Basis**
No. of Operating Days	Days	300	
No. of Shifts/ Hours	No. / Hours	15	
Proposed Investment			
Plant & Machinery	` (in lakh)	0.52	
Civil Work	` (in lakh)	0.00	
Erection & Commissioning	` (in lakh)	0.00	
Misc. Cost	` (in lakh)	0.00	
Total Investment	` (in lakh)	0.52	
Financing pattern			
Own Funds (Equity)	` (in lakh)	0.13	Feasibility Study
Loan Funds (Term Loan)	` (in lakh)	0.39	Feasibility Study
Loan Tenure	Years	5.00	Assumed
Moratorium Period	Months	6.00	Assumed
Repayment Period	Months	66.00	Assumed
Interest Rate	%age	10.00%	
Estimation of Costs			
O & M Costs	% on Plant & Equip	2.00	Feasibility Study
Annual Escalation	%age	2.00	Feasibility Study
Estimation of Revenue			
Electricity Savings	kWh/Year	3783.3	
Cost of Coal	`/kWh	5	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

Estimation of Interest on Term Loan **` (in lakh)**

Years	Opening Balance	Repayment	Closing Balance	Interest
1	0.39	0.02	0.37	0.05
2	0.37	0.06	0.31	0.03
3	0.31	0.08	0.23	0.03
4	0.23	0.10	0.14	0.02
5	0.14	0.10	0.04	0.01
6	0.04	0.04	0.00	0.00
		0.39		

WDV Depreciation **`(in lakh)**

Particulars / years	1	2
Plant and Machinery		
Cost	0.52	0.10
Depreciation	0.41	0.08
WDV	0.10	0.02

Projected Profitability **` (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Electricity savings	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Total Revenue (A)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Expenses								
O & M Expenses	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total Expenses (B)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PBDIT (A)-(B)	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Interest	0.05	0.03	0.03	0.02	0.01	0.00	0.00	0.00
PBDT	0.13	0.14	0.15	0.16	0.17	0.18	0.18	0.18
Depreciation	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
PBT	0.11	0.12	0.12	0.13	0.14	0.15	0.15	0.15
Income tax	0.00	0.02	0.05	0.05	0.06	0.06	0.06	0.06
Profit after tax (PAT)	0.11	0.10	0.07	0.08	0.08	0.09	0.09	0.09

Computation of Tax **` (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Profit before tax	0.11	0.12	0.12	0.13	0.14	0.15	0.15	0.15
Add: Book depreciation	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Less: WDV depreciation	0.41	0.08	-	-	-	-	-	-
Taxable profit	(0.28)	0.06	0.15	0.16	0.17	0.18	0.18	0.18
Income Tax	-	0.02	0.05	0.05	0.06	0.06	0.06	0.06

Projected Balance Sheet **` (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Share Capital (D)	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Reserves & Surplus (E)	0.11	0.20	0.27	0.35	0.44	0.53	0.62	0.70
Term Loans (F)	0.37	0.31	0.23	0.14	0.04	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	0.61	0.64	0.64	0.62	0.60	0.66	0.74	0.83
Assets	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross Fixed Assets	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Less Accumulated Depreciation	0.03	0.05	0.08	0.11	0.14	0.16	0.19	0.22
Net Fixed Assets	0.49	0.46	0.44	0.41	0.38	0.35	0.33	0.30
Cash & Bank Balance	0.11	0.18	0.20	0.21	0.22	0.30	0.42	0.53
TOTAL ASSETS	0.61	0.64	0.64	0.62	0.60	0.66	0.74	0.83
Net Worth	0.24	0.33	0.40	0.48	0.57	0.66	0.74	0.83
Debt Equity Ratio	2.85	2.40	1.80	1.05	0.30	0.00	0.00	0.00

Projected Cash Flow **` (in lakh)**

Particulars / Years	0	1	2	3	4	5	6	7	8
Sources									
Share Capital	0.13	-	-	-	-	-	-	-	-
Term Loan	0.39								
Profit After tax		0.11	0.10	0.07	0.08	0.08	0.09	0.09	0.09
Depreciation		0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Total Sources	0.52	0.13	0.12	0.10	0.11	0.11	0.12	0.12	0.12
Application									
Capital Expenditure	0.52								
Repayment Of Loan	-	0.02	0.06	0.08	0.10	0.10	0.04	0.00	0.00
Total Application	0.52	0.02	0.06	0.08	0.10	0.10	0.04	0.00	0.00

Particulars / Years	0	1	2	3	4	5	6	7	8
Net Surplus	-	0.11	0.07	0.02	0.01	0.01	0.08	0.12	0.12
Add: Opening Balance	-	-	0.11	0.18	0.20	0.21	0.22	0.30	0.42
Closing Balance	-	0.11	0.18	0.20	0.21	0.22	0.30	0.42	0.53

IRR **` (in lakh)**

Particulars / months	0	1	2	3	4	5	6	7	8
Profit after Tax		0.11	0.10	0.07	0.08	0.08	0.09	0.09	0.09
Depreciation		0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Interest on Term Loan		0.05	0.03	0.03	0.02	0.01	0.00	-	-
Cash outflow	(0.52)	-	-	-	-	-	-	-	-
Net Cash flow	(0.52)	0.18	0.16	0.13	0.12	0.12	0.12	0.12	0.12
IRR	21.49 %								
NPV	0.21								

Break Even Point **` (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Variable Expenses								
O & M Expenses (75%)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sub Total(G)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed Expenses								
O & M Expenses (25%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on Term Loan	0.05	0.03	0.03	0.02	0.01	0.00	0.00	0.00
Depreciation (H)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Sub Total (I)	0.08	0.06	0.06	0.05	0.04	0.03	0.03	0.03
Sales (J)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Contribution (K)	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Break Even Point (L= G/I)%	41.40%	35.50%	31.85%	27.11%	21.80%	17.39%	16.80%	16.85%
Cash Break Even {(I)-(H)}%	26.30%	20.39%	16.72%	11.98%	6.64%	2.22%	1.62%	1.65%
Break Even Sales (J)*(L)	0.08	0.07	0.06	0.05	0.04	0.03	0.03	0.03

Return on Investment **` (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8	Total
Net Profit Before Taxes	0.11	0.12	0.12	0.13	0.14	0.15	0.15	0.15	1.07
Net Worth	0.24	0.33	0.40	0.48	0.57	0.66	0.74	0.83	4.25
									25.13%

Debt Service Coverage Ratio **` (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	0.11	0.10	0.07	0.08	0.08	0.09	0.09	0.09	0.53
Depreciation	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.16
Interest on Term Loan	0.05	0.03	0.03	0.02	0.01	0.00	0.00	0.00	0.14
Total (M)	0.18	0.16	0.13	0.12	0.12	0.12	0.12	0.12	0.83

DEBT

Interest on Term Loan	0.05	0.03	0.03	0.02	0.01	0.00	0.00	0.00	0.13
Repayment of Term Loan	0.02	0.06	0.08	0.10	0.10	0.04	0.00	0.00	0.39
Total (N)	0.06	0.09	0.11	0.12	0.11	0.04	0.00	0.00	0.53
DSCR (M/N)	2.77	1.70	1.21	1.07	1.13	2.94	0.00	0.00	1.57
Average DSCR	1.57								

Annexure 4: Procurement and implementation schedule

S. No.	Activities	Weeks						
		1	2	3	4	5	6	7
1	Identification of Old and inefficient motors							
2	Planning and material order							
3	Procurement							
4	Commissioning							

Annexure 5: Break-up of Process down Time

S No	Activities	Weeks		
		7/7	7/7	7/7
1	Dismantling of Old Motor			
2	Installing New Motor in Place of Old En-efficient Motors			
3	Testing & Trial			

Annexure 6: Details of technology service providers

Source of product	Details of Local vendor / service provider
Bharat Bijlee Ltd	Mr. Rakesh Verma Sr. Manager – Marketing rakesh.verma@bharatbijlee.com 09871861872
ABB Ltd	Mr. Neeraj Verma ABB Ltd Power Product SCO-13-14-15 Sector-34A Chandigarh Phone: 0172-4321845 Telefax: 0172-2601618 Mobile: 09878613484 email: neeraj.verma@in.abb.com
Kirloskar Brothers Ltd	Mr. Kamlesh Gupta Station Road Alwar Tel.: +91 (144) 2700226 Mob. : +91 9414019126/ 09414019126
Havells, Epcos	Mr. Sachin Hope Circus , Alwar -301001 Tel. : +91 (144) 2337886 (O) (R) 0144-2330971
Vijay Agencies	Mr.Jagdish Agarwal Opp Shiv Mandir , Station Bazaria, Sawai-Madhopur Tel 07462-220678 (O) 222577 (R)

Annexure 7: Quotations or Techno-commercial bids for new technology / equipment

Bharat Bijlee

CE eff1

FLAME PROOF MOTORS (Standard Motors)

For foot mounted (B3 construction), 415V ±10%, 50Hz ±5%,combined variation ±10%, 3 phase supply, Insulation Class F,Degree of Protection IP55,Ambient Temperature 45°C,Conforms to IS:325, IS:2148, Gas Group IIA,IIB.

3000 rpm 2 Pole					
Kw	Hp	Frame	Type	LP33	Excise
0.37	0.50	80	MJ0802A3	20380	997
0.55	0.75	80	MJ080283	22690	1110
0.75	1.00	80	MJ080213	23310	1140
1.10	1.50	80	MJ080233	26050	1274
1.50	2.00	90 L	MJ09L243	29120	1425
2.20	3.00	100L	MJ10L213	45000	2202
3.70	5.00	112M	MJ11M233	52820	2584
5.50	7.50	132 M	MJ13M253	65440	3202
7.50	10.00	132 M	MJ13M293	72360	3540
9.30	12.50	160M	MJ16M233	130300	6375
11.00	15.00	160 M	MJ16M253	134210	6566
15.00	20.00	160 M	MJ16M263	153250	7498
18.50	25.00	160 L	MJ16L293	176070	8614
22.00	30.00	180 L	MJ18L233	207460	10150
30.00	40.00	200 L	MJ20L2A3	280670	13732
37.00	50.00	200 L	MJ20L253	363170	17768
45.00	60.00	225 M	MJ22M253	459380	22475
55.00	75.00	280S	MJ28S213	717820	35119
75.00	100.00	280M	MJ28M233	750010	36694
90.00	120.00	280 M	MJ28M253	831280	40670
110.00	150.00	315S	MJ31S233	868100	42472
125.00	170.00	315M	MJ31M2A3	1018790	49844
132.00	180.00	315M	MJ31M233	1029370	50362
150.00	200.00	315L	MJ31L2A3	1131040	55336
160.00	215.00	315L	MJ31L253	1166970	57094
180.00	240.00	315L	MJ31L2B3	1399060	68449
* 200.00	270.00	315L	MJ31L273	1747190	85481

1500 rpm 4 Pole					
Kw	Hp	Frame	Type	LP33	Excise
0.37	0.50	80	MJ080413	20230	990
0.55	0.75	80	MJ080433	22050	1079
0.75	1.00	80	MJ080453	22900	1120
1.10	1.50	90 L	MJ09L423	26040	1274
1.50	2.00	100L	MJ10L453	33960	1661
2.20	3.00	112M	MJ11M433	38570	1887
3.70	5.00	132M	MJ13M433	54520	2667
5.50	7.50	132 M	MJ13M473	62550	3060
7.50	10.00	160M	MJ16M4A3	99480	4867
9.30	12.50	160 M	MJ16M4C3	109290	5347
11.00	15.00	160 M	MJ16M4K3	115460	5649
15.00	20.00	180L	MJ18L433	152340	7453
18.50	25.00	180 L	MJ18L473	161640	7908
22.00	30.00	200L	MJ20L433	224550	10986
30.00	40.00	200 L	MJ20L453	256450	12547
37.00	50.00	225M	MJ22M433	332890	16287
45.00	60.00	250M	MJ25M4A3	465310	22765
55.00	75.00	250 M	MJ25M413	517000	25294
75.00	100.00	280 S	MJ28S413	664300	32501
90.00	120.00	280 M	MJ28M433	684810	33504
110.00	150.00	315S	MJ31S413	769320	37639
125.00	170.00	315M	MJ31M4A3	885360	43316
132.00	180.00	315M	MJ31M433	922210	45119
150.00	200.00	315L	MJ31L4A3	958800	46909
160.00	215.00	315L	MJ31L453	968600	47389
180.00	240.00	315L	MJ31L463	1159390	56723
* 200.00	270.00	315L	MJ31L473	1395660	68283

*Rating suitable for 4Uc

Eff1 will be marked on name plate as per IS 12615: 2004 for
2 Pole- 0.37kW to 160Kw 4 Pole- 0.37kW to 160Kw

Authorised by : A M Naik

Bharat Bijlee

CRANE & HOIST DUTY SQUIRREL CAGE MOTORS

B 3 Construction, 415V ±10%, 50Hz ±5% Combined variation ±10%, Insulation Class F, Degree of Protection IP55, Ambient Temperature 45° C, Duty S4, CDF 40%, Starts/Stops 150 per hour, Conforms to IS : 325.

750 rpm 8 Pole					
Kw	Hp	Frame	Type	LP33	Excise
0.55	0.75	90S	MC09S813	13050	638
0.75	1.00	90L	MC09L863	14270	698
1.10	1.50	100L	MC10L813	17640	858
1.50	2.00	100L	MC10L833	21370	1046
2.20	3.00	112M	MC11M833	24780	1212
3.70	5.00	132S	MC13S863	36020	1762
5.50	7.50	160M	MC16M833	54050	2644
7.50	10.00	160L	MC16L873	79680	3898
9.30	12.50	180M	MC18M813	103680	5068
11.00	15.00	180L	MC18L833	109100	5338
15.00	20.00	200L	MC20L833	154150	7542
18.50	25.00	225S	MC22S813	198880	9730
22.00	30.00	225M	MC22M833	240060	11745
30.00	40.00	250M	MC25M813	322800	15793
37.00	50.00	280S	MC28S823	412670	20186
45.00	60.00	280M	MC28M863	478660	23418
55.00	75.00	315S	MC31S813	572970	28033
75.00	100.00	315M	MC31M833	720870	35269
90.00	120.00	315M	MC31M863	809920	39625
110.00	150.00	315L	MC31L873	855220	41842
132.00	180.00	315L	MC31L893	1001610	49004

Note:

1. Prices mentioned are maximum recommended selling prices and c subjecte to change without notice.
2. Prices are Ex-Works / EX-Godown exclusive of Excise duty, t tax and other Central / Local levies which will be charged extra
3. kW & HP are indicated, howver kW is binding and HP is approxi

Extra Price Calculations.

a) Wherver percentage is mentioned, add to LP and then offer c

b) Where absolute values are mentioned, same to be directl to the nett price(No discount applicable ob absolute values).

Authorised by : A M Naik

BBL/LP-33 Effective from 21st Mar'2011

On the list price offer discount of 55 % + ED + Vat for retail customer. For enquiries of motors more than 5 prices are negotiable.

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
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