

A

PROJECT REPORT

ON

MANUFACTURE OF AUTOMOBILE PISTON

PREPARED BY

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OCTOBER 2012**

PROJECT PROFILE

PRODUCT : AUTOMOBILE PISTON

PRODUCT CODE : 331159000 (SAMPLE)

CATEGORY : MECHANICAL

QUALITY & STANDARDS : IS 12025 : 1987

MONTH & YEAR : OCTOBER, 2012

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INTRODUCTION

The automotive industry is the key driver of any growing economy. The automobile industry comprises automobile and auto component sectors. The component production range includes engine parts 31%, drive transmission and steering parts 19%, suspension and braking parts 12%, electrical parts 10%, equipments 12%, body and chassis 9% and others 7%. Indigenous firms like Bharat Forge, Sundaram Fasteners, Minda Industries and Gabriel India Ltd. are in the limelight in auto component sector.

This project report is mainly focussed on manufacture of "automobile piston", one of the most demanding engine parts.

MARKET POTENTIAL

The Indian automobile industry is growing at a very high rate with sales of more than one million passenger vehicles per annum. The overall growth rate is 10-15 % for automobile industry and 28 % for automobile component sector annually. Today's competitive market has put all major automobile companies upfront to design and develop varieties of vehicles as per customer demands. The replacement market is also likely to expand. This indicates scintillating prospects for much faster growth and development of new auto component industry.

The Auto Component Manufacturers Association (ACMA) has pegged domestic demand for auto components at \$ 20-25 billion in 2015 from current demand of approximately \$ 10 billion.

BASIS AND PRESUMPTIONS

1. The production capacity of the unit has been worked out on the basis of single shift of 8 hours a day for 300 working days a year (i.e, 25 days a month).
2. The unit is expected to work at 70% efficiency of installed capacity with yield rate of 95%.
3. Wages for labour, etc. have been considered as per the prevailing market rates in accordance with the Minimum Wages Act. The proprietor is considered as the Manager.
4. The unit is assumed to run in a rented/leased building.
5. The cost of machinery and equipments have been taken as per the rates quoted by manufacturers/suppliers.
6. The cost of raw material and other inputs are based on current prices prevailing in local market.
7. Interest rate for fixed and working capital investment have been calculated on an average rate of 16%.

IMPLEMENTATION SCHEDULE

S.No.	Name of Activity	Period
1.	Preparation of Project Report	
1(a)	Market survey	4 Weeks
1(b)	Calling Quotations	6 Weeks
1(c)	Scheme Preparation	2 Weeks
2.	Provisional registration as SSI (EM1)	4 Weeks
3.	Clearance from Pollution Control Board	4 Weeks
4.	Financial arrangement from banks/financial institutions	8 Weeks
5.	Selection of site for unit	3 Weeks
6.	Purchase of Plant, Machinery and Equipments	8 Weeks
7.	Erection, Electrification and Commissioning of Machines	4 Weeks
8.	Procurement of Raw Materials, Tools, Guages and Measuring Equipments, etc.	3 Weeks
9.	Recruitment of Staff and Workers	4 Weeks
10.	Trial run and Commencement of Production	1 Weeks
Total =		51 Weeks

TECHNICAL ASPECTS

Automobile Piston - Introduction :

In an Internal Combustion engine, piston converts the thermal energy of fuel into mechanical energy. The main functions of the piston are :-

- (a) To transmit the gas forces via connecting rod to the crank shaft.
- (b) To seal in conjunction with the piston rings and combustion chamber against gas leakage to the crankcase and to prevent the infiltration of oil from crankcase into the combustion chamber.
- (c) To dissipate absorbed combustion heat to the cylinder liner and cooling oil.

Operating Conditions :

Pistons are subject to high mechanical and thermal loads. The mechanical loads on the piston result from extreme pressure cycles with peak pressures upto 200 bar in combustion chamber and huge forces of inertia caused by extremely high acceleration during the reciprocating motion of piston. The thermal loads on the piston result from combustion process with peak gas temperatures in the combustion chamber between 1800 to 2600 °C.

For pistons, these challenges translate into maximum strength requirements in the relevant temperature range combined with minimum weight.

Raw Material :

Aluminium Alloys are the preferred material for pistons both in gasoline and diesel engines due to their specific characteristics :- low density, high thermal conductivity, easy machinability, high reliability and very good recycling characteristics. Proper control of the chemical composition, processing conditions and final heat treatment results in a micro structure which ensures the required mechanical and thermal performance, in particular the high thermal fatigue resistance.

The standard material for piston is Al-12%Si alloy containing in addition approximately 1% each of Cu, Ni and Mg.

Process of Manufacture :

The aluminium alloy is formed into roughly shaped piston blanks either by casting or forging. Thereafter, piston blanks are machined to final specification.

Cast Pistons : They are most common due to the simpler and less expensive manufacturing processes involved. The majority of pistons are produced by gravity die casting process.

Forged Pistons : They are made from higher strength aluminum alloy billets which are pressed into their basic shape rather than poured. Forged pistons have a finer microstructure than cast pistons with the same alloy composition.

Details of Processes involved in Manufacture of Piston by Casting Process :-

- 1. Foundary :** Foundary is the beginning of piston manufacturing. At the foundary, die is prepared for taking molten aluminium alloy by heating it to operating temperature for approximately one hour. This process allows the die to readily accept the molten material when it is poured. The process starts by heating the aluminium alloy well above the melting point but below its boiling point, i.e, upto 700°C. Molten aluminium alloy is then poured into the die through sprue. The material is then allowed to cool into the die by placing it into a bin of hot water. Thereafter, the casting is prepared to ensure improved qualities.
- 2. Pin Boring :** At this stage, the piston casting has the gudgeon pin hole rough machined and the locating bung (i.e, base of the casting) machined to allow placement of the casting in other machines. The locating bung is turned on a simple lathe, thereafter pin boring is carried out on a pin borer.
- 3. Turning :** Turning of the piston casting is carried out on precision lathe machines. The castings are placed in the lathe on a bung and held in place by a solid rod through the gudgeon pin hole. A draw bolt is activated in the chuck which draws the rod towards chuck and holds the piston in place. The piston is now ready for finishing processes.

4. Finishing Processes :

- (a) The first stage of finishing processes include drilling oil holes in gudgeon pin bosses and oil ring grooves, cutting slots in the skirt, valve relieving and crank relieving.
- (b) Grinding : This process involves the final size being machined on the piston. The process involved is cam grinding which machines the skirt of the piston only.
- (c) Reaming : This is the final machining process which involves the piston being placed in a bath of oil and reamed to reach the final size required.

5. Pin Fitting and Final Inspection : At this stage, the piston is cleaned, fitted with gudgeon pin, size and category stamped and then sent to dispatch.

Quality Controls & Standards :

As per IS 7793 : 1975, Aluminium Alloys for I.C engine pistons; basically four grades of the alloys have been specified namely – 2285, 4658, 4928-A and 4928-B with various alloying compositions like Si, Cu, Mg, Fe, Mn, Ni, Zn, etc.

Hardness has been specified between 90 to 140 HB with tensile strength ranging from 165 to 275 N/mm² for various grades.

Pollution Control :

As foundry shop is there which requires strict measures to minimize pollution. Therefore consent of the State Pollution Control Board is essentially required which will remain valid till the unit modifies or changes its process.

Energy Conservation :

There is a little scope for energy conservation in this industry except in the foundry, where the furnace should be properly insulated to reduce radiation losses and should be fitted with automatic pyrometer control to maintain proper temperature in the furnace.

Production Capacity :

Production Capacity (Per annum) = Prod'n. rate per hour X Yield rate X
Efficiency X Hours per shift X No. of shift
per day X No. of working days per month
X No. of month per annum

Here,

Prodn. rate per hour = 12

Yield rate = 95%

Efficiency = 70%

Hours per shift = 8 hours

No. of shift per day = 1 shift

No. of working days per month = 25 days

No. of month per year = 12 months

Now,

Production Capacity (Per annum) = 12 x .95 x .70 x 8x 1 x 25 x 12

= 19152 Nos.

= 19000 Nos. (Say)

FINANCIAL ASPECTS

1. FIXED CAPITAL

(i) Machines & Equipments :

S.No.	Particulars	Qty.	Rate per unit(In Rs)	Amount(In Rs)
1.	Crucible type Tilting Furnace (Electric), 250 kg	4	70000/-	280000/-
2.	Boring Machine	1	50000/-	50000/-
3.	Lathe Machine, Bed length 4'6", swing dia 350 mm, 1.5 KW / 2 H.P	4	60000/-	240000/-
4.	Precision Lathe Machine	2	80000/-	160000/-
5.	Pillar type Drilling Machine, 0.5 H.P	1	35000/-	35000/-
6.	Bench Grinder double ended, 0.25 H.P	1	15000/-	15000/-
7.	Tempering Furnace, 400°C	1	70000/-	70000/-
7.	Laboratory comprising chemical and physical testing	1	200000/-	200000/-
8.	Bench-Vice, Table, Fixtures, Measuring Instruments, Moulding box, Die, Guages, etc	L.S	100000/-	100000/-
9.	Generator and Other Electrical Accessories	1	100000/-	100000/-
Total =				1250000/-

(ii) Pre-Operative Expenses : Rs 70000/-

(iii) Electrical and Mechanical installation @ 10% of Plant and Machinery cost :

Rs 125000/-

(iii) Office/Lab. Furniture & Equipments : Rs 100000/-

Total Fixed Capital = 1545000/-

2. WORKING CAPITAL (PER MONTH)

(i) Salary & Wages :

S.No.	Salary and Wages	Nos.	Salary (In Rs)	Amount (In Rs)
1.	Supervisor	2	12000/-	24000/-
2.	Storekeeper	1	7000/-	7000/-
3.	Office Assistant	1	9000/-	9000/-
4.	Skilled Worker	4	10000/-	40000/-
5.	Semi-skilled Worker	5	8000/-	40000/-
6.	Unskilled Worker	3	7000/-	21000/-
7.	Maintenance Fitter	1	9000/-	9000/-
Total =				150000/-
Perquisites (i.e, Bonus, Incentives, Allowances) @ 15% =				22500/-
Grand Total =				172500/-

(ii) Raw Materials :

S.No.	Raw/Input Material	Qty.	Rate per unit	Amount (In Rs)
1.	Aluminium Alloy, Al-12%Si	480 Kg(considering piston wt 300 gm)	110/-	52800/-
2.	Packing Material (Moulded hard paper cartoon)	1600 Nos.	7/-	11200/-
Total =				64000/-

(iii) Utilities :

S.No.	Utilities	Consumption	Rate per unit	Amount (In Rs)
1.	Electricity	4000 Unit	5/-	20000/-
2.	Fuel	200 Litre	50/-	10000/-
3.	Water	100 KL	10/-	1000/-
Total =				31000/-

(iv) Other Contingent Expenses :

S.No.	Particulars	Amount (In Rs)
1.	Building rent	25000/-
2.	Insurance	10000/-
3.	Office stationary and postage	3000/-
4.	Publicity and advertisement	8000/-
5.	Travelling and conveyance	7000/-
6.	Legal and other expenses	5000/-
7.	Repair and Maintenance	8000/-
8.	Consumable stores	6000/-
9.	Miscellaneous expenses, i.e, Taxes, etc.	20000/-
Total =		92000/-

Total Working Capital, i.e, Recurring Expenditure (For 1 Month) = 359500/-

Total Working Capital, i.e, Recurring Expenditure (For 3 Month) = 1078500/-

Total Capital Investment (Fixed+Working) = 2623500/-

FINANCIAL ANALYSIS

1. Cost of Production (Per annum)

S.No.	Particulars	Amount (In Rs)
1.	Total annual Recurring Cost	4314000/-
2.	Depreciation on Machines & Equipments @10% (Excluding furnace)	90000/-
3.	Depreciation on Furnace @20%	70000/-
4.	Depreciation on Office/Lab Furniture & Equipments @20%	20000/-
5.	Interest on total Capital Investment @16%	419760/-
Total =		4913760/-

2. Turn-over (Per annum)

S.No.	Item	Sold Qty. (In nos.)	Rate per unit including VAT @ 13%	Amount (In Rs)
1.	Automobile Piston	19000	360	6840000/-

3. Net Profit (Per annum)

$$\begin{aligned}\text{Net Profit (Per annum)} &= \text{Total turn over (Per annum)} - \text{Total cost of prodn. (Per annum)} \\ &= 6840000 - 4913760 \\ &= \mathbf{1926240/-}\end{aligned}$$

4. Profit Ratio

$$\begin{aligned}\text{Net Profit Ratio} &= (\text{Net profit per annum} / \text{Total turnover per annum}) \times 100 \\ &= (1926240 / 6840000) \times 100 \\ &= \mathbf{28.16 \%}\end{aligned}$$

5. Rate of Return (On Investment)

$$\begin{aligned}\text{Rate of Return} &= (\text{Net profit per annum} / \text{Total capital investment}) \times 100 \\ &= (1926240 / 2623500) \times 100 \\ &= \mathbf{73.42 \%}\end{aligned}$$

6. Break Even Point (B.E.P)

Fixed Cost

S.No.	Particulars	Amount (In Rs)
1.	Interest on total capital investment	419760/-
2.	Total depreciation	90000/-
3.	Building rent	25000/-
4.	Insurance	10000/-
5.	40% of other contingent expenses (excluding rent and insurance)	22800/-
6.	40% of salary and wages	69000/-
Total =		636560/-

Break Even Point (B.E.P) = [Fixed cost / (Fixed cost + Profit)] x 100

$$= [636560 / (636560 + 1926240)] \times 100$$

$$= \mathbf{24.84 \%}$$

ADDRESSES OF MACHINE & EQUIPMENT SUPPLIERS

1. Precision Machine Tools
16/1, Gopi Nath Estate, Part – II,
Swami Narayan Chamber, NH-8
Ahmedabad – 382 415.
 2. J.P Machine Tools Private Ltd.,
1575, G.T Road, Dholewal Chowk
Ludhiana – 141 003.
 3. Simplex Engg. Works,
G.T Road, ASR Bypass Chowk,
Batala, Punjab.
 4. Steel Fast Engg. (P) Ltd.,
16/2, Mathura Road,
Karkhana Bagh,
Faridabad – 121 002.
 5. D.G Enterprise,
J.N Bose Road, Subhash Park,
Kolkata – 700 147.
- For lathe, boring, drilling and grinding m/c
- For crucible furnaces

ADDRESSES OF RAW MATERIAL SUPPLIERS

1. Kolisetty Alloy Castings
16-H, IDA, Balanagar,
Hyderabad.
2. Aluminium World,
Opp. Hari Masjid,
Old Mondha Road,
Aurangabad (Maharashtra).
3. Bharat Aluminium India,
Nath Madhav Road,
Ist Khattar Gali,
C.P Tank,
Mumbai.