

# **AUTO PISTONS AND PISTON RINGS**



## **1. INTRODUCTION:**

Pistons of majority auto vehicles are no made of aluminum and produced by Gravity casting of Aluminium alloy. They are also made from cast iron and steel alloys for heavy duty vehicles and large capacity generator or marine engines. Piston Rings are used as gas sealing element on piston. They are normally made of cast iron alloys due to better wear and lubricating properties and better oil film retention properties.

## **2. PRODUCT & ITS APPLICATION:**

Auto piston is a part of automobile which reciprocates in the engine cylinder to transmit power to the wheels. A piston is a component of reciprocating engines, reciprocating pumps, gas compressors and hydraulic and pneumatic cylinders, among other similar mechanisms use pistons and piston rings. It is the moving component that is contained by a cylinder and is made gas-tight by piston rings. In an engine, its purpose is to transfer force from expanding gas in the cylinder to the crankshaft via a piston rod and/or connecting rod. In a compressor or pump, the function is reversed to pressurize or eject gas or fluid.

Pistons and rings are used in automobile industries and auto vehicles in huge quantity and the OE manufacturers and replacement trade are its main customers.

## **3. DESIRED QUALIFICATIONS FOR PROMOTER:**

The promoter with experience in automobile component production and technical knowledge of alloying and piston and ring geometry achievement through machining and knowledge of heat treatment and having mechanical / metallurgical engineering background will be able to manage the project well.

#### **4. INDUSTRY OUTLOOK/TREND**

Asia is expected to emerge as the largest market due to increasing vehicle production and demand, growing vehicle population, improvement in the economic conditions, and increasing investments by the industry players within the APAC region. North America and Asia Pacific are expected to witness significant growth over the next decade because of rapidly increasing demand of filters in OEMs as well as the replacement or aftermarkets.

The auto-component industry of India has expanded by 14.3 per cent because of strong growth in the spares or after-market sales to reach at a level of Rs 2.92 lakh crore (US\$ 44.90 billion) in the year 2017. The auto-components industry accounts for almost seven per cent of India's Gross Domestic Product (GDP) and employs as many as 25 million people, both directly and indirectly.

At present, there are more than 30 manufacturers in large and small medium sector of various types of pistons and ring set manufacturers for 2, 3 and 4 wheel vehicle engines, off road and earth moving machines and standby power generating sets. The unit clusters are mainly located in North Indian centers like Punjab, Haryana, Delhi and West UP, in Maharashtra around Pune and Bombay and Southern India near Bangalore, Chennai and Hyderabad, in Gujarat around Rajkot and Surendranagar.

#### **5. MARKET POTENTIAL AND MARKETING ISSUES. IF ANY:**

India's passenger vehicles of around 29 million during 2015 are expected to grow to more than 48 million vehicles by 2020. With the increasing automobile demand, the country is also proportionately expected to witness a surge in replacement components for these vehicles.

Apart from automobiles, air and gas compressors mining equipment, trucks, buses, trains, generator sets, forklifts and other types of engine require pistons and rings. The demand is expected to expand at an average growth rate of 15%. The replacement market is also likely to expand. There also exists good demand for export of quality products for replacement markets overseas.

## **6. RAW MATERIAL REQUIREMENTS:**

Auto pistons are made of alloy aluminum and these alloys are required in ingot form. Al. Alloys for I.C. Engine Pistons, basically four grades of the alloys have been specified by IS 7793 namely 2285, 4658, 4928 - A and 4928 - B with various alloying compositions like Cu, Mg, Si, Fe, Mn, Ni, Zinc etc. are required. Hardness has been specified between 90 to 140 HB with tensile strength ranging from 165 to 275 N/mm<sup>2</sup> for various grades.

Piston rings and diesel engine pistons require pig iron/ cast iron and steel scrap. The preferred material for compression rings is a low-alloyed, heat-treated nodular cast iron that is achieved in melt while casting. Various alloying additives for elements like molybdenum, chromium, silicon, manganese etc. are required for achieving desired alloy compositions.

## **7. MANUFACTURING PROCESS:**

Aluminum pistons are used for most passenger vehicles like two, three and four wheelers. Though heavy duty engines like diesel engines use forged and cast steel piston. For automotive applications, Pistons and rings must have performance properties and durability. These are essentially obtained through heat treatment and proper geometry profile for piston crowns as well as piston rings.

The piston material has to be chosen closer to its operating temperature limits and designed to improve the thermal management. New, high performance aluminum alloys and coatings, with good casting technology and machining and give desired performance.

Piston rings materials require high bending strength and modulus of elasticity, and increased hardness of 320 to 470 HB is produced in order to obtain the

required wear resistance in the uncoated condition. The demand for high wear strength is met by the use of a tempered, alloyed cast iron. The good wear resistance results from the combination of a fine pearlitic matrix structure and finely dispersed, precipitated secondary carbides.

It is, therefore, essential that the proper alloy selection, casting techniques, surface heat treatment and machining with close tolerances are achieved for optimum product quality with minimum cost.

Gravity Die Casting as well as sand mold casting is suggested for casting of pistons and rings. The melting and holding furnaces give desired alloys that are cast and thereafter cast components are machined with attachments and tooling on lathes/ milling drilling machines to get desired profiles and size. These components are then heat treated, machined for surface properties. The grinding and lapping after heat treatment and coating gives finished product.

## **8. MANPOWER REQUIREMENT:**

The unit shall require highly skilled service persons. The unit can start from 20 employees initially and increase to 52 or more depending on business volume.

Sr. No.	Type of Employees	Monthly Salary	No of Employees				
			Year 1	Year 2	Year 3	Year 4	Year 5
1.	Skilled Operators	18000	8	12	16	18	20
2.	Semi-Skilled/ Helpers	9000	8	12	16	18	24
3.	Supervisor/ Manager	25000	1	2	2	3	3
4.	Accounts/ Marketing	18000	1	1	3	3	3
5.	Other Staff	8000	2	2	2	2	2
	TOTAL		20	29	39	44	52

## **9. IMPLEMENTATION SCHEDULE:**

The unit can be implemented within 7 months from the serious initiation of project work.

The unit is based on selection of location, renting premises for the unit.

<b>Sr. No.</b>	<b>Activities</b>	<b>Time Required in Months</b>
1	Acquisition of Premises	1
2	Construction (if Applicable)	2
3	Procurement and Installation of Plant and Machinery	3
4	Arrangement of Finance	2
5	Manpower Recruitment and start up	2
	Total Time Required (Some Activities run concurrently)	7

## **10. COST OF PROJECT:**

The unit will require total project cost of Rs 162.50 lakhs as shown below:

<b>Sr. No.</b>	<b>Particulars</b>	<b>In Lakhs</b>
1	Land	25.00
2	Building	45.00
3	Plant and Machinery	58.35
4	Fixtures and Electrical Installation	4.05
5	Other Assets/ Preliminary and Preoperative Expenses	2.50
6	Margin for working Capital	27.60
	<b>TOTAL PROJECT COST</b>	<b>162.50</b>

## **11. MEANS OF FINANCE:**

The project will require promoter to invest about Rs 61.33 lakhs and seek bank loans of Rs 101.18 lakhs based on 70% loan on fixed assets.

<b>Sr. No.</b>	<b>Particulars</b>	<b>In Lakhs</b>
1	Promoters Contribution	61.33

2	Loan Finance	101.18
	TOTAL :	162.50

## 12. WORKING CAPITAL REQUIREMENTS:

Working capital requirements are calculated as below:

(Rs. Lakh)

Sr. No.	Particulars	Gross Amount	Margin %	Margin Amount	Bank Finance
1	Inventories	16.02	40	6.41	9.61
2	Receivables	23.04	50	11.52	11.52
3	Overheads	3.26	100	3.26	0.00
4	Creditors	16.02	40	6.41	9.61
	TOTAL	58.35		27.60	30.75

## 13. LIST OF MACHINERY REQUIRED:

Sr. No.	Particulars	UOM	Quantity	Rate	Total Value
	Main Machines/ Equipment				
1	Melting Furnace for Al Alloy and steel/cast iron alloys	Nos.	3	250000	750000
2	Gravity/ low pressure Die casting machine 1kg / shot	Nos.	1	650000	650000
3	Mold spray unit		1	45000	45000
4	Trimming Press 15T capacity	Nos.	1	35000	35000
5	Pin Lift Molding Machine		1	60000	60000
6	Sand Mixer, sieves etc.	Nos.	1	50000	50000
7	Surface Finish Tumbling machine		1	45000	45000
8	Polishing Belt grinder		1	15000	15000
9	Heat Treatment Furnaces		2	180000	360000
10	Shot blasting machine		1	80000	80000
11	CNC Lathe		1	850000	850000
12	Cylindrical Grinder		1	650000	650000
12	Lapping Machine for Rings		2	300000	600000
13	Lathe machine		2	55000	110000
14	Drilling Machine		2	65000	130000
15	Milling Machine		1	750000	750000
16	Granite Surface Block and Dial gauges etc.		1	175000	175000

Sr. No.	Particulars	UOM	Quantity	Rate	Total Value
	subtotal :				5355000
	Tools and Ancillaries				
1	Die tools and gauges	LS	1	250000	250000
2	Misc. tools etc.	LS	1	230000	230000
	subtotal :				480000
	Fixtures and Elect Installation				
	Storage racks and trolleys	LS	1	30000	30000
	Other Furniture	LS	1	35000	35000
	Telephones/ Computer	LS	1	40000	40000
	Electrical Installation	LS	1	300000	300000
	subtotal :				405000
	Other Assets/ Preliminary and Preoperative Expenses	LS	1	250000	250000
	<b>TOTAL PLANT MACHINERY COST</b>				<b>6490000</b>

All the machines and equipment are available from local manufacturers. The entrepreneur needs to ensure proper selection of product mix and proper type of machines and tooling to have modern and flexible designs. It may be worthwhile to look at reconditioned imported machines, dies and tooling. Some of the machinery and dies and tooling suppliers are listed here below:

1. Techno Machines  
Chikkanahalli Road,  
Opp. Shahi Exports (Unit No 6),  
Near Annapoorneshwari Temple, Bommanahalli,  
BENGALURU-560 068, INDIA
2. S. S. Engineering Works  
Ajit Khanna(Proprietor)  
Plot No. 100, Sector 6 IMT Manesar, Gurgaon - 122050, Haryana, India
3. Taurus Private Ltd Co

No. 24, D 2 / E 3, Kiab Industrial, Area At Pivele  
 Kiab Industrial Area  
 Bengaluru - 560100 Karnataka, India

4. Micro Engineering Works;  
 No. 6/140, Gandhi Nagar, Nallampalayam Road Nanjai Gounden, Pudur,  
 G. N. Mills Post, Coimbatore - 641029, Tamil Nadu, India
5. S. G. Profile  
 Plot No. 201/1, Gala No. 56, Morya Industrial Estate, MIDC, Bhosari,  
 Bhosari Midc,  
 Pune-411026, Maharashtra, India

Other well known machine manufacturers can be searched from directories/  
 internet. Some are listed here below:

- ACME TOOLINGS, D-67, Phase 1, IDA Jeedimetla, Hyderabad - 500055,
- Ace Manufacturing Systems Ltd.,
- Batliboi Ltd. Mumbai,
- Bharat Fritz Werner Ltd.,
- HMT Machine Tools Ltd.,
- Advani Oerlikon Ltd, Bombay,
- Lakshmi Machine Works Ltd.,
- Lokesh Machines Ltd.,
- Praga Tools Ltd.,
- Toolcraft Systems Pvt. Ltd.

#### 14. PROFITABILITY CALCULATIONS:

Sr. No.	Particulars	UOM	Year Wise estimates				
			Year 1	Year 2	Year 3	Year 4	Year 5
1	Capacity Utilization	%	35	45	60	70	80
2	Sales	Rs Lakhs	276.50	355.50	474.00	553.00	632.00



3	Raw Materials & Other Direct Inputs	Rs Lakhs	192.30	247.24	329.65	384.59	439.54
4	Gross Margin	Rs Lakhs	84.20	108.26	144.35	168.41	192.46
5	Overheads Except Interest	Rs Lakhs	24.96	24.96	24.96	24.96	24.96
6	Interest	Rs Lakhs	14.16	14.16	14.16	14.16	14.16
7	Depreciation	Rs Lakhs	13.19	13.19	13.19	13.19	13.19
8	Net Profit Before Tax	Rs Lakhs	31.89	55.95	92.04	116.09	140.15

The basis of profitability calculation:

The Unit will have capacity of 700 MT of Pistons and rings per year of assorted types/ designs. The sales prices of Liners of various types range from Rs 100 to Rs 3000 per piece and that of rings range from Rs 50 to 600 per piece depending or more depending on type, metal composition, and volumes. The raw material cost of Aluminum ingots is ranging from 130 to 170 per kg and cast iron scrap ranges from 25 to 35 per Kg depending on grades. The material requirements are considered with wastage/ scrap/burnouts etc of 6 % of finished products as most of generated scrap is reused. The unusable scrap is sold at @ Rs 15 ~ 30 per Kg. and the income of same is added. Energy Costs are considered at Rs 7 per Kwh and fuel cost is considered at Rs. 65 per liter. The depreciation of plant is taken at 10 % and Interest costs are taken at 14 -15 % depending on type of industry.

## 15. BREAK EVEN ANALYSIS

The project is can reach break-even capacity at 21.74 % of the installed capacity as depicted here below considering the high value product mix.

Sr. No.	Particulars	UOM	Value
1	Sales at Full Capacity	Rs Lakhs	790.00
2	Variable Costs	Rs Lakhs	549.42
3	Fixed Cost incl. Interest	Rs Lakhs	52.31
4	Break Even Capacity	% of Inst Capacity	21.74

## **16. STATUTORY/ GOVERNMENT APPROVALS**

The unit will require state industry unit registration with District Industry center. No other procedures are involved. For export, IEC Code and local authority clearances. The industry registration and approval for factory plan, safety etc. is required as per factory inspectorate and labor laws. Other registration are as per Labor laws are ESI, PF etc. Before starting, the unit will also need GST registration for procurement of materials as also for sale of goods. As such there is no pollution control registration requirement, however the unit will have to ensure safe environment through installation of chimney etc as per rules. Solid waste disposal shall have to meet the required norms.

## **17. BACKWARD AND FORWARD INTEGRATION**

The machines and equipment offer scope for diversification in to producing other consumer and industrial parts/ components and parts. The unit can utilize the spare capacities of furnace and machining capabilities. As such there is not much scope for organic backward or forward integration. The entrepreneur needs to ensure proper selection of product mix and also be careful in maintaining key product parameters in terms of dimensions, tolerances and geometric profiles along with final weights of products. The material selection, processes including heat treatment and achievement of final properties are key to quality and success of project.

## **18. TRAINING CENTERS/COURSES**

There are no specific training centers for production technology. However foundry technology can be obtained by joining as apprentice in foundry units. The Prototype Development Centers can provide some assistance and for foundry technology, casting, machining, dies and Tools development, courses run by centers of excellence viz Indo German Tool Room at Ahmedabad, Rajkot, Chennai, etc shall be helpful.

The most important scope of learning is in new product design and development by study of the new product designs, product range, features and specifications of leading Brands / competitors across the world by scanning the Internet and downloading data from websites of Viz. North American, Europe, China etc markets.

Udyamimitra portal (link: [www.udyamimitra.in](http://www.udyamimitra.in)) can also be accessed for hand-

holding services viz. application filling / project report preparation, EDP, financial Training, Skill Development, mentoring etc. Entrepreneurship program helps to run business successfully is also available from Institutes like Entrepreneurship Development Institute of India (EDII) and its affiliates all over India.

**Disclaimer:**

Only few machine manufacturers are mentioned in the profile, although many machine manufacturers are available in the market. The addresses given for machinery manufacturers have been taken from reliable sources, to the best of knowledge and contacts. However, no responsibility is admitted, in case any inadvertent error or incorrectness is noticed therein. Further the same have been given by way of information only and do not carry any recommendation.

Source:- Udyami Mitra/Sidbi