

INVESTMENT CASTINGS

(LOST WAX CASTING PROCESS)

1. INTRODUCTION:

Investment Casting is a metal casting process which employs an expendable pattern of wax and one piece ceramic mold. This process is also known as Precision Casting because it eliminates the parting line and reduces the machining cost. This process is also known as lost wax method. Investment casting is used to manufacture parts ranging from turbocharger wheels to golf club heads, from electronic boxes to hip replacement implants.

It is possible to cast almost all metals, namely ferrous as well as non-ferrous. However it is most suitable for expensive and intricate component manufacturing like hard and high strength metals and alloys, which are difficult to machine such as Stainless and Tool Steels. This process is also used for medical implants and jewelry products made from precious metals like gold, silver and platinum.

In general, the components made by this process find extensive application in each and every sphere of life ranging from domestic use to industrial use.

2. PRODUCT & ITS APPLICATION:

Investment casting is used for metals from Stainless Steel alloys to with high strength titanium, molybdenum etc. alloy steels, that find tremendous application in Chemical, Pharmaceutical, Dairy, Power Generation and Aircraft / jet engine and aerospace industries for critical components such as Screws, Fuel Lines, Engine Parts, Heat Exchangers, Turbine blades, casings, Valves etc. . Most of it conforms to austenitic, ferritic and martensitic grade steel alloys that are also suitable for Heat Treatment.

The consumers of precision investment casting are mainly Automobile, Defense, Nuclear, Engineering Instrumentation, and Pumps & Valves in domestic market.

3. DESIRED QUALIFICATIONS FOR PROMOTER:

Preferably mechanical or metallurgical graduate with experience in this technology.

4. INDUSTRY OUTLOOK/TREND

The demand for the investment castings is very high in aerospace sector in US and Europe countries, while Asian countries are growing in automotive and bio-medical sectors. The investment casting industry in Asia is mainly producing investment castings for automotive turbocharger, gas turbines and bio-medical, automotive and chemical/ pharma industry industrial valve parts. It appears that worldwide Investment casting industry is likely to grow and demand shall grow in view of good performance of end user segments in upcoming years and Asia is set for leadership and strong future growth.

There are about 200 industrial investment casting foundries in India, in comparison with over 4500 sand and die-casting foundries. The demand as also production has grown in most of the investment casting foundries in last decade for domestic as well as export markets. Most of the Indian investments casting foundries are located in Rajkot, Kolhapur and Coimbatore. Investment casting foundries are very less in number compared to other types (about 3.5 % of total foundries). Most of Indian investment casting foundries is equipped with modern wax injection machine and robotic shelling system. The precision casting products produced by this industry is mostly used in manufacture of industrial valves, pumps and machinery, automotive components and defense sectors. Investment Casting Clusters are very important and it can play a major role in the country to provide future demand for critical components for defense and other industries as well for other domestic and export markets. There existing and new units can enhance their capability of manufacturing super alloy castings used in aerospace, defense and bio-medical industries as these foundries are currently manufacturing industrial castings of stainless steel for automobile and chemical industries.

5. MARKET POTENTIAL AND MARKETING ISSUES. IF ANY:

Chemical, Pharmaceutical, Power Generation, Aircraft and aerospace Industries and Dairy Equipment etc. require a number of special castings such as alloy Steel Castings in different sizes and shapes. In addition, the requirement of tool steel components has also gone on increasing with the pace of industrial development.

The investment casting products in India are mostly catering to Industrial Valves, pumps, Impellers, and precision machinery parts almost 65 %, auto parts 28% and aerospace/defense sector account for 7%. The total size of the industry is over Rs 3000 crores in terms of revenue. Investment casting production and demand in India has increased by approximately 10-12% per year in past decade from domestic and export sector and future growth rate is likely to continue in this range.

It is also forecast that Indian investment casting producers will capture new opportunities of global market with rapid strides made in economy of India. The rapid development of high-tech equipment encourages the demand of investment castings from Asia. Though China is one of the largest investment casting producers in Asia with approximately 550 foundries, India is also emerging as major center for investment castings for aerospace and automotive etc. sector.

Alloy Steel Castings units with special super alloys used in aerospace are negligible. A few units are producing castings are not of the standards and specifications. In view of the above, there is immense scope for setting up Investment casting unit with induction melting and metallurgical quality control facilities. Make in India policy will help to cater to upcoming demand from Defense, aerospace, auto and other high tech sectors. Entrepreneurs may focus on manufacture of intricate precious metal products.

6. RAW MATERIAL REQUIREMENTS:

The raw materials – are Steels viz. Stainless Steel, Heat Resistant, Corrosion Resistant, Tool Steel & even High-Speed Steel), Brass, Bronze & Aluminum Alloys. The basic steel materials are either in form of ingots or made from melting and alloying of scrap steel.

Other consumables required are waxes of different grades and refractory powder and Ferro alloying elements.

7. MANUFACTURING PROCESS:

Precision Investment Castings by 'LOST WAX PROCESS' can be used for up to a single piece weight of 100 Kgs in a variety of Materials - Steels viz. Stainless Steel, Heat Resistant, Corrosion Resistant, Tool Steel & even High-Speed Steel, Even Brass, Bronze & Aluminum Alloys are cast by this method for large component castings.

The main stages of the Lost wax Process are the following...

- Precision Die Development as per Customer drawing for wax pattern molding
- Injection of wax into the dies.
- Joining of multiple wax molds into a master wax pattern as tree for casting mold.
- Covering of pattern tree by spraying refractory material (Shell making).
- Baking of ceramic mold shell and de-waxing from ceramic shell
- Sintering of refractory material in shells to make a strong mold for casting
- Melting of metal as per composition in furnace and Pouring the melt in shell
- Removal of Ceramic material to get the casting
- The cast metal is processed to cut-off risers/ gates etc.
- Finishing is done by grinding of ingrates, sand blasting,
- Surface treatments and heat treatment processes are carried out followed by machining as per customer dimensions. The mechanical & electro polishing, hot dip galvanizing may be carried out.
- Product under goes Final material and metrological Inspection
- Packing & Dispatch
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Manufacture of Master Pattern and shell mould baking/ sintering are critical processes. Often various grades of soft and hard waxes are mixed to get desired Wax with specific melting temperature. Investment Wax pattern coated with Slurry of refractory powder of proper properties and particle size are important for the quality and finish of castings.

8. MANPOWER REQUIREMENT:

The unit shall require highly skilled service persons. The unit can start from 15 employees initially and increase to 34 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	6	8	10	12	12
2	Semi-Skilled/ Helpers	8000	6	8	12	16	16
3	Supervisor/ Manager	25000	1	1	2	2	2
4	Accounts/ Marketing	16000	1	1	2	2	2
5	Other Staff	8000	1	1	2	2	2
	TOTAL		15	19	28	34	34

9. IMPLEMENTATION SCHEDULE:

The unit can be implemented within 8 months from the serious initiation of project work.

Sr. No	Activities	Time Required in Months
1	Acquisition of Premises	2
2	Construction (if Applicable)	2
3	Procurement and Installation of Plant and Machinery	2
4	Arrangement of Finance	2
5	Manpower Recruitment and start up	2
	Total Time Required (Some Activities run concurrently)	8

10. COST OF PROJECT:

The unit will require total project cost of Rs 191.28 lakhs as shown below:

Sr. No	Particulars	In Lakhs
1	Land	20.00
2	Building	35.00
3	Plant and Machinery	69.75
4	Fixtures and Electrical Installation	10.90
5	Other Assets/ Preliminary and Preoperative Expenses	3.50
6	Margin for working Capital	52.13
	TOTAL PROJECT COST	191.28

11. MEANS OF FINANCE:

The project will require promoter to invest about Rs 86.92 lakhs and seek bank loans of Rs 104.36 lakhs based on 70% loan on fixed assets.

Sr. No	Particulars	In Lakhs
1	Promoters Contribution	86.92
2	Loan Finance	104.36
	TOTAL :	191.28

12. WORKING CAPITAL REQUIREMENTS:

Working capital requirements are calculated as below:

Sr. No	Particulars	Gross Amount	Margin %	Margin Amount	Bank Finance
1	Inventories	38.83	40	15.53	23.30
2	Receivables	31.20	50	15.60	15.60
3	Overheads	5.47	100	5.47	0.00
4	Creditors	38.83	40	15.53	23.30
	TOTAL	114.32		52.13	62.19

13. LIST OF MACHINERY REQUIRED:

Sr. No	Particulars	UOM	Quantity	Rate	Total Value
	Main Machines/ Equipment				
1	Medium Freq Induction Furnace 1000 kg	Nos	1	4500000	4500000
2	Cooling tower, Water softening plant, heat exchanger	Nos	1	800000	800000
3	Wax Melting/ holding furnace, molding machine with wax injector	Nos	1	150000	150000
4	Refractory Slurry mixer	Nos	1	25000	25000
5	Refractory Tree Drying oven	Nos	1	30000	30000
6	Core Baking oven with wax recovery unit	Nos	1	25000	25000
7	Wax tree table with refractory sprayer unit	Nos	2	35000	70000
8	Ladle with heating system	Nos	2	35000	70000
9	EOT Crane	Nos	1	350000	350000
10	Shot blasting machine	Nos	1	80000	80000
11	Lathe Machine	Nos	2	100000	200000
12	Drilling Machine	Nos	1	65000	65000
13	Mold Boxes and tools	LS	1	250000	250000
14	Bench/ Flexible shaft grinders	Nos	2	30000	60000
	subtotal :				6675000
	Tools and Ancillaries				
1	Patterns tools and gauges	LS	1	200000	200000
2	Misc. tools etc.	LS	1	100000	100000
	subtotal :				300000
	Fixtures and Elect Installation				
	Storage racks and trolleys	LS	1	30000	30000
	Other Furniture	LS	1	20000	20000
	Telephones/ Computer	LS	1	40000	40000
	Electrical Installation	LS	1	1000000	1000000
	subtotal :				1090000
	Other Assets/ Preliminary and Preoperative Expenses	LS	1	350000	350000
	TOTAL PLANT MACHINERY COST				8415000

All the machines and equipment are available from local manufacturers. The entrepreneur needs to ensure proper selection of product mix and proper type of dies 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. Pmp Machine Tools
Behind Raj Kamal Petrol Pump,
Punit Nagar Road, Kotharia, Raj Nagar, Rajkot-360004
2. Shree Mayur Engineering Company
1New LaL Bahadur Nagar,
Virani Aghat,Dhebar Road,
Rajkot-360002 Gujarat(India)
3. Eddy Melt
C 70, M. I. D. C., Hingna Industrial Estate,
Nagpur – 440025 Maharashtra, India
4. Electrotherm India Ltd.,
Survey No. 72,
Village Palodia, Taluka Kalol Via Thaltej
Ahmedabad- 382115, Gujarat,
5. ShouryaEquipments Private Limited
Office No 05 Gat No. 103,
Sitai Plaza NigditalAwade Road Talawade,
Pune-411062, Maharashtra, India
6. Shree Krishna Pharma Machinery
No. 2, Vinayak Estate,
Near Pharmatech, Changodhar, Changodar,
Ahmedabad-382213

7. Western Industrial Applications Private Limited
No. B-3081, Oberoi Garden Estates,
Chandivali, Andheri, Mumbai-400072

14. PROFITABILITY CALCULATIONS:

Sr. No	Particulars	UOM	Year Wise estimates				
			Year 1	Year 2	Year 3	Year 4	Year 5
1	Capacity Utilization	%	40	50	60	70	80
2	Sales	Rs Lakhs	374.41	468.01	561.61	655.21	748.81
3	Raw Materials & Other Direct Inputs	Rs Lakhs	310.63	388.29	465.94	543.60	621.26
4	Gross Margin	Rs Lakhs	63.78	79.72	95.67	111.61	127.56
5	Overheads Except Interest	Rs Lakhs	29.12	29.12	29.12	29.12	29.12
6	Interest	Rs Lakhs	14.61	14.61	14.61	14.61	14.61
7	Depreciation	Rs Lakhs	11.92	11.92	11.92	11.92	11.92
8	Net Profit Before Tax	Rs Lakhs	8.14	24.08	40.03	55.97	71.92

The Unit will have capacity of 600 MT Investment castings per year of Carbon Steel and stainless steel etc. alloys and super alloys of different grades/ types. The bulk sale/ distribution sales prices ranges from Rs 150 per Kg to Rs1500 per kg for super alloys and intricate castings, depending on metal alloy grades, size and volumes.

The raw material cost of alloys ranges from Rs 45 per kg for carbon steel alloys to Rs 250 to Rs 400 per Kg for high grade alloys, stainless steels and super alloys. Other materials like wax of different grades price ranges from Rs 60 to Rs 400 Kg or more and that of refractory / ceramic materials and furnace melt additives costs from Rs 10 per kg to Rs 250 per kg. The material requirements are considered with wastage/ scrap etc. of 6% to 10 % of finished products. The unusable scrap is sold at @ Rs 18 ~ 130 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 42.02 % of the installed capacity as depicted here below:

Sr. No	Particulars	UOM	Value
1	Sales at Full Capacity	Rs Lakhs	936.02
2	Variable Costs	Rs Lakhs	776.57
3	Fixed Cost incl. Interest	Rs Lakhs	55.64
4	Break Even Capacity	% of Inst Capacity	34.09

16. STATUTORY/ GOVERNMENT APPROVALS

The unit shall have to get state industrial unit registration from DIC, IEC Code for Export and local authority clearance. Depending on structure of finance the company shall need to register company with registrar of companies. The registration and approval for factory plan, safety for Fire etc. requirement, registration as per Labour laws ESI, PF etc. shall be required as per rules and applicability. 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 requirements, except installation of chimney/ blowers for heat treatment furnace / pickling line and ensure safe environment as per rules of factory safety. Solid waste disposal shall have to meet the required norms. Entrepreneur may contact State Pollution Control Board where ever it is applicable.

17. BACKWARD AND FORWARD INTEGRATION

The machines and equipment offer little scope for diversification to except to produce different application products of intricate / engraved designs used in fashion industry/ murals etc. The unit can also of other consumer and industrial products / components etc. by using the spare capacities and machine capabilities. As such there is not much scope for organic backward or forward integration.

18. TRAINING CENTERS/COURSES

There are no specific training centers for wire drawing technology. There are training for dies and tools development run by several centers of excellence viz Indo German Tool Room at Ahmedabad, Rajkot, Chennai, and CTTC Bhubaneswaretc. shall be helpful.

The most important scope of learning is in new product design and development by associating with institutes like NID etc. Entrepreneur may also study the new product designs, product range, features and specifications of leading Brands / competitors across the world by scanning the Internet and downloading data. Viz. North American, Europe, China etc. markets.

Udyamimitra portal (link : 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.