

EXECUTIVE SUMMARY

- 0.1 The term investment casting is used to describe a group of processes in which moulds are produced from liquid refractory slurries and the pattern around which this slurry is coated is made out of wax through wax injection machine. Castings made by this route give high standards of dimensional accuracy, surface finish and design flexibility and unlike pressure die casting, is applicable to alloys of virtually any composition.
- 0.2 In India the commercial scale production of precision investment castings for industrial application was taken up in early sixties when one unit in the small scale sector was set up with Swiss collaboratoin. However, the scenario in seventies completely changed when 3 more units were set up in the country with separate foreign collaborations. Simultaneously more units in the small scale sector were also set up.
- 0.3 The Department of Scientific and Industrial Research (DSIR), under the Ministry of Science and Technology had identified to study the status of technology in the field of precision investment casting to bring out the present status of the technology in India, which has primarily been imported, its absorption, adaptation and technolgy gaps vis-a-vis state of art and international scenario. Consequent to this DSIR commissioned the National Industrial Development Corporation Ltd. (NIDC) to prepare a draft technology status report on precision investment casting under the National Register of Foreign Collaboration (NRFC).
- 0.4 The Methodology adopted for the study comprised of desk research as well as field visits. The field visits comprised of discussions with majority of the precision investment casting manufacturers and leading end-users in the country, professional bodies and institutes of repute in the field. Contacts were also made with manufacturers and organisations concerned with precision investment castings around the world to get a good glimpse of the international scenario.
- 0.5 In India there are about 4500 foundries of which only 17 are known to be producing precision investment castings. These units include one captive facility at Hindustan Aeronautics Limited (HAL), Koraput. Four of these units are in medium scale sector and the remaining units in small scale sector. The precision investment casting foundries in the country feed to various sectors of industry including, aerospace, railways, defence, automobile and other miscellaneous industries like pumps, compressors, valves and artificial limbs etc. The product-mix of various manufacturers largely depends on the customer requirements and the industry has so far produced castings more than 200 ferrous and non-ferrous alloys involving in the weight range of few grams to 40 kg. piece weight.

- 0.6 The first collaboration agreement for the manufacture of precision investment castings was entered into by Plycast (Delhi) with Alsteg, Switzerland and since then four other foreign collaborations have also been entered into. All the agreements except one with IPCL and FHH have since expired. Collaboration profile of precision investment casting manufacturers is given in Table 1:
- 0.7 There are five major manufacturers of precision investment castings in the country besides one captive facility at HAL and other small scale units. The total installed capacity is estimated to be 1100 tonnes/year. Against this installed capacity, production during the year 1986-87 was of the order of 535 tonnes valued at Rs. 874 lakhs. The total exports of precision investment casting during the year 1987-88 was Rs. 16 lakhs.
- 0.8 The main process of manufacture involved in the production of precision investment castings includes production of disposable wax pattern, investment, wax pattern removal, firing, melting of metal/alloy, casting and fettling. A few of the units still depend on imported wax and ceramic material specially molachite. Plant and equipment installed at all the units are more or less similar and comprise of induction melting furnaces, wax injection machines, slurry mixers, fluidized bed for dry ceramic coating, ovens for wax melting, baking and fettling equipment. A few units have very sophisticated inspection and testing facilities and have very stringent quality control procedures. One unit is manufacturing investment castings by using CLA process.
- 0.9 The technology with respect to precision investment casting around the world is changing very fast and new technology/processes/machines have been developed. These include vacuum induction melting (VIM) and Argon Oxygen Decarburisation (AOD) processes, CLA process, ceramic core making and removal, introduction of mechanised handling systems including robots, improved risering techniques and vacuum heat treatment of castings, etc.
- 0.10 The technology for the manufacture of precision investment casting imported over 15 years ago has been fully absorbed and adapted. Indian collaborators have been in a position to improvise and indigenize the designs and some of the raw materials imported and have also devised and evolved new and innovative methods for production of such castings.
- 0.11 Based on the study the following major recommendations can be made:

Due to lack of knowledge of its scope and application, the use of precision investment castings is still limited. In view of this, it is pertinent to start vigorous marketing efforts by existing leading manufacturers to educate people and help them in deciding on substitutional possibilities. This effort can further be augmented by holding seminars by concerned agencies to discuss possible areas of new applications.

**Table 1 Collaboration Profile of Precision Investment
Casting manufacturers in India**

S No.	Description	PLYCAST	KANTHAL	UNIFERRO International Ltd.	IPCL		SHIWAJI WORKS
					ARWOOD	FHH	
1.	Company Status	Private Sector (Small Scale)	Private Sector	Private Sector	Private Sector		Private Sector
2.	Establishment	1962	1971	1975	1979		1900
3.	Factory Location	Faridabad (Haryana)	Pune	Bombay	Bhavnagar		Solapur
4.	Foreign Collaboration	ALSTEG (Switzerland)	Bulten Kanthal AB (Sweden)	Uni Deritend UK	Arwood USA Germany	FHH West	M/s HITCH INERmfg. Co. Inc. USA
5.	Year of Collaboration	1962	1971	1975	1979	1984	1978
6.	Nature of Collaboration	Technical know how	Equity & Technical know how	Technical know how	Technical know how		Technical know how
7.	Installed Capacity (Tonne/year)	60	60	400	150		50
8.	Total Fixed Assets (Rs. Lakh)	41.53	87.55	205	87		35.06
9.	Imported Equipment (Percent)	100	90	75	100		N/A
10.	Payment Terms	Initial payment	Royalty 5%	Royalty 3%	-Initial payment -Royalty 3%	-Initial payment -Royalty 3%	Initial payment 3% Royalty
11.	Training & Expatriate Assistance	Provided	Provided	Provided	Provided	Provided	Provided
12.	Validity	Expired	Expired	Expired	Expired	Valid	Expired
13.	Buy Back	No	No	No	No	No	No
14.	Technology Export	Possible	Possible	Possible	Permission required		Possible

- Barring a few units, the process adopted and the equipment installed at other units are 10-15 years old. Though the units have done innovative jobs of their own, the units have not kept themselves abreast with the latest developments around the world. The old plant and equipment also need modernization and replacement to achieve better efficiency and economy.
- Efforts be made to speedily indigenize the raw material requirement, such as, wax for patterns, for precision investment castings. This can be done by expediting the installation of Indrol's speciality wax plant in collaboration with Dussak Campbell, U.S.A. Similarly successful indigenization efforts made by few manufacturers in respect of ceramic materials should be made available to others by horizontally transferring the technology. These companies can be suitably compensated for such services to fellow competitors.
- Special and liberal fiscal benefits be granted for export of precision investment castings and they may not be equated with other castings as is being done now, since these are high value added items and need special support to increase exports.
- Induction of vacuum melting technology to produce vacuum alloys should be done.
- Efforts may also be made to procure technologies from external sources for the manufacture of directional solidified (DS) castings, monocrystalline castings and castings in the heavier weight ranges (above 40 kg.).
- R & D efforts in the country with respect to precision investment casting manufacture and applications are limited to a few leading manufacturers only. It is recommended that a central R & D unit at NIFFT be developed. Developmental activities undertaken by manufacturers and other institutions be encouraged. The substitutional or developmental projects can be sponsored by Government and the expenditure subsidized. Additionally it should be obligatory for all the R & D set ups of the manufacturers to get recognition from Ministry of Science & Technology.
- Knowledgable persons in the field felt that regular training facilities for precision investment castings be taken up at ITI and NIFFT etc. On the job training can, however, be undertaken at the manufacturers' work.
- The automobile industry in the country can harness the investment casting technology for the manufacture of small components and give a lead to other industry. They can probably afford to set up a separate R & D to work on substitutional aspects of introducing this route of manufacture for automobile components.
- In future collaboration arrangements, if any, buy back arrangement, provision for export of technology to third countries, R & D feed back etc. must find suitable place in favour of the importing country.